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ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

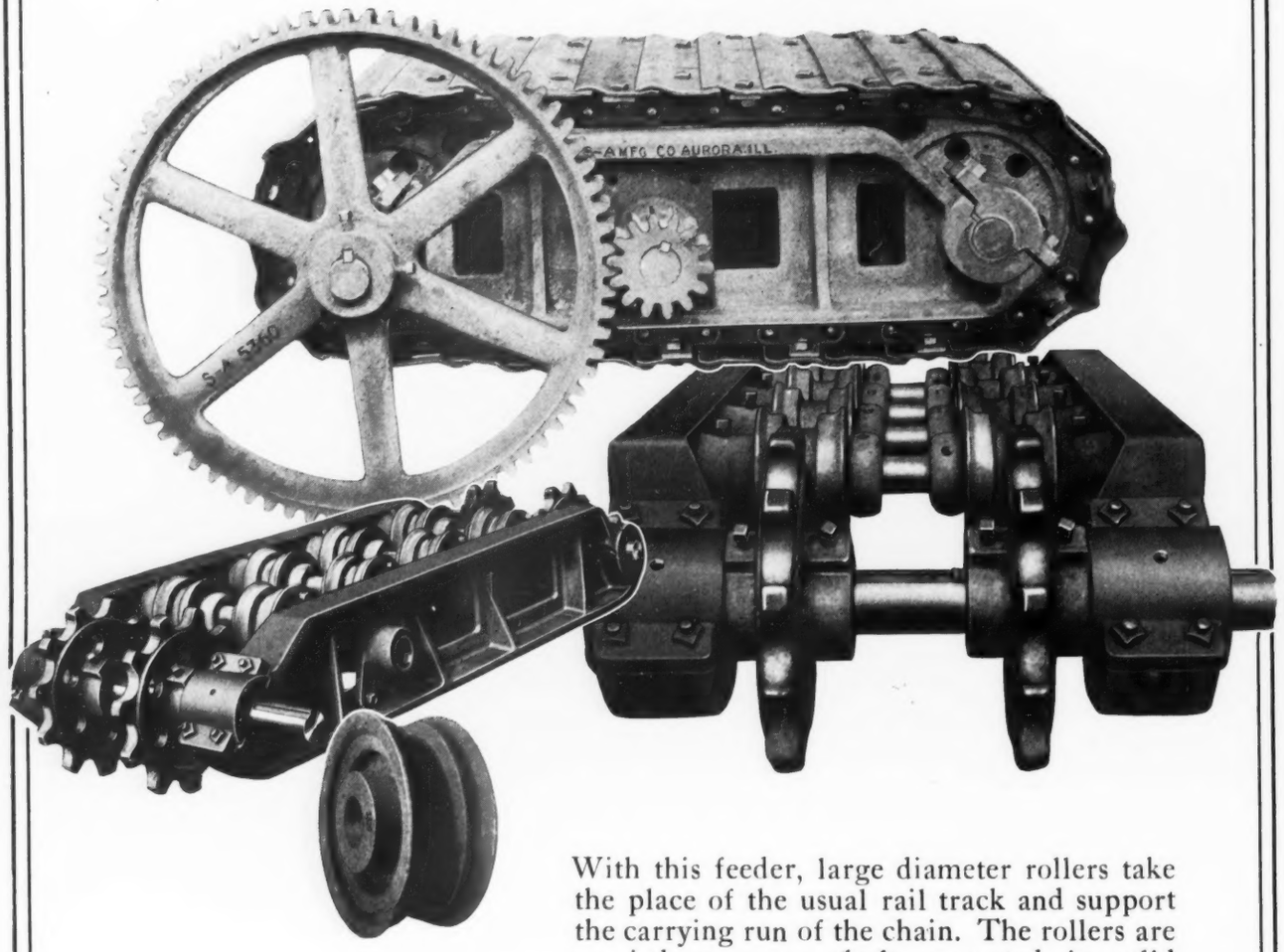
Drilling a 227-foot prospecting hole with hammer drill and sectional drill rods in Chief Consolidated mine, Eureka, Utah

All rods and couplings shown, weighing about 900 lb., were used in this hole at one time. Obviously the entire rod was not moved by each blow of the 14-lb. piston hammer but rather a flow of high-frequency vibrations was expended by the action of the drill bit against the rock (see page 384). The double-column set-up permits proper alignment of drill and is more rigid.

Deep-Hole Drilling with Hammer Drills and Sectional Drill Rods, by Howard R. Drullard

S-A Steel Apron Feeders

Roller Track Type



We carry in stock self-contained feeders of the type illustrated. Other sizes and types can be furnished promptly.

With this feeder, large diameter rollers take the place of the usual rail track and support the carrying run of the chain. The rollers are carried on cross shafts mounted in solid bearings which rest on the cast framework. Spaced at close intervals the rollers are placed and so designed that the load is carried thru the side links of the Chain. This arrangement relieves the otherwise severe wear on the small chain rollers. With this design the rollers are engaged only when passing around the sprockets. This feeder is built in widths up to 60 inches and in any lengths to suit requirements.

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JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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Empire Mining and Metallurgical Congress

PRELIMINARY NOTICES have been received announcing the holding of an Empire Mining and Metallurgical Congress at London on June 3 to 6, the objects of which comprise (1) the presentation and discussion of scientific and technical papers; (2) the constitution of an Empire Council of Mining and Metallurgical Institution, the purpose of which will be to facilitate intercommunication, promote the interests of mining engineering, aid in the maintenance of technical efficiency and professional status; and (3) establish a register of British mining and metallurgical engineers. The Congress will be held at the British Empire Exhibition, which in itself is expected to attract millions of visitors from all parts of the world.

Among the signatures of the preliminary announcement we note the name of R. Gilman Brown, president of the Institution of Mining and Metallurgy, a graduate of Columbia University, and honorably known as an American mining engineer of high standing and a technician of prominence. This fact should indicate that interest and support for the Congress from this side of the Atlantic should prove worth while to all concerned.

The Congress, in addition to the Institution of Mining and Metallurgy, will comprise the Institution of Mining Engineers, the Institution of Petroleum Geologists, the Iron and Steel Institute, the Institute of Metals, the Mining Associate of Great Britain, the National Federation of Iron and Steel Manufacturers, the Canadian Institution of Mining and Metallurgy, the Australasian Institute of Mining and Metallurgy, the Chemical, Metallurgical and Mining Society of South Africa, the South African Institution of Engineers and the Mining and Geological Institute of India. The American Institute and the Mining and Metallurgical Society will be officially represented; and whatever concern we may feel at the outcome of the domestic problems that confront the sister organizations in the British Empire, it should be recognized that the deliberations and results of the Congress may prove of significant moment to mining engineering in general, and that its decision and actions will probably have a profound effect on professional ethics and technical standards in our profession throughout the English speaking world.

Atmospheric Control Apparatus

THE FORWARD MARCH of progress in scientific endeavor is irresistible. A few years ago a significant step was taken in appraising the correct atmospheric conditions in which workers could produce at maximum efficiency, and minimum fatigue and discomfort. An instrument known as the kata-thermometer was invented by Dr. Leonard Hill, the physiologist; it consists of a double-bulbed spirit thermometer, with a large bulb at the bottom and a small bulb at the top. The connecting glass tube is graduated between 100 and 95 deg. F., the mean of which may be taken as the average temperature of the human body. The instrument is first placed in hot water, whereby the spirit is made to rise into the top bulb; it is then dried and placed in the atmosphere of which an estimate of cooling power is required, and the time taken for the spirit to drop from the 100- to the 95-deg. mark is noted. The lower bulb may be covered with a wetted muslin sleeve; if the instrument is used thus, the cooling is due to convection, radiation and evaporation. If used dry, it is due to convection and radiation. The difference between the two readings gives the measure of cooling by evaporation.

The kata-thermometer, as developed by Dr. Hill, has been demonstrated to be of immense value in factories and mines, where thermometer readings give no indication of the cooling power of the air, in spite of the immense importance of this factor in the maintenance of healthful conditions. However, the need for the preliminary preparation of the instrument before each reading indicated inherent clumsiness of utilization of the idea, a drawback that recently has been obviated by Dr. E. H. J. Schuster, who has invented a kata-thermometer that is automatic in operation, by which a continuous record of atmospheric cooling power is recorded. The instrument is arranged to be heated at regular intervals by an automatic contrivance, the duration of the cooling period being registered as part of a curve. This latest refinement in invention obviates personal attention and control. The new instrument will doubtless find wide application in mines, factories and offices, where individual output, whether mental or physical, is dependent to a large extent on satisfactory atmospheric conditions.

Marketing Diamonds

DIAMONDS are a luxury. Vanity and the love of a sparkle, the appreciation of beauty, the desire of ownership and the portability of the concentrated money value represented by the diamond are the motives that support the diamond market. Salesmen in some instances, particularly oil-stock salesmen, adorn themselves with sparklers of no mean proportions. With a background of an accentuated check suit of clothes, the combination no doubt exercises a hypnotic influence upon the "prospects" approached. The aura of prosperity is enhanced by the diamond, which may be called the finishing touch to other accessories. All of this contributes to the support of the diamond miner.

Systematic diamond mining regularized as well as increased the supply, with the result that the price, which was more or less stable and high, became more and more uncertain. Joint action of the principal producers, has, however, kept the price under control.

The De Beers Consolidated Mines has built up a highly successful business in mining and marketing diamonds. The methods adopted by the company are

of no little interest. In the last annual report of the De Beers Consolidated Mines, P. Ross Frames, chairman of the board of directors, states:

"It seems that it cannot too often be repeated that the value of diamonds lies almost entirely in the control of the quantity put upon the market; the diamond has practically no intrinsic value; it has a certain limited value for industrial purposes, but the quantity required for these purposes is comparatively small, and it certainly would not pay to work the mines in order to satisfy the requirements of this very small market. A recognition of these facts and stern necessity compelled the great diamond producers some years ago to combine with the object of regulating the quantity of diamonds to be put upon the market and to maintain prices. There can be little doubt that but for this action of the greater producers, diamonds today would be practically valueless, and many of the undertakings at present engaged in the mining of these precious stones would be bankrupt or closed down.

"The irony of the position lies in the fact that as a result and direct consequence of the 'Big Four' continuing to control and regulate output and prices, they are shut out of the market until every other producer in the world has sold every stone he has, and then, and not until then, are we privileged to satisfy whatever demand they have been unable to meet.

"In the last few years the demand for diamonds has been considerably less than it was during the years immediately preceding and following peace, and today it is difficult to say what the market is; it changes with every change of the European situation; a speech, a threat, a rumored conference, and the market improves or the demand melts away.

"These changes, so far as they showed a downward tendency, created great alarm at times, and would probably have resulted in disaster had not the four great producers relieved the Syndicate, who at times carried very heavy stock, by suspending some of the more onerous conditions of their contracts, and thus made it possible for them to withhold diamonds from a congested market. It is not always possible, certainly it is not always wise, under extraordinary conditions to hold people to the terms of a contract entered into under normal circumstances. It is better to preserve the cow that yields your daily milk than to sacrifice her in order to get the hide, horns, and hoofs. The Syndicate has, through the co-operation of the great producers, recouped some of its losses, which at one time promised to be almost overwhelming; but a better understanding now exists between the producers and the Syndicate, and it is realized by both sides that their interests must stand or fall together. The question arises at times, however, whether some method or machinery for the sale of diamonds cannot be devised which will give results more satisfactory to the producers than those at present obtaining. A change under the present unsettled conditions requires a great deal of courage, and might delay payment of dividends."

The Engineer as Citizen

WHAT KIND of a citizen is the average mining engineer? A few statistics are impressive.

The American Institute of Mining and Metallurgical Engineers has over 9,000 membership. The attendance this year at the New York meeting was the largest on record. About 800 registered the first day.

Of these about 40 attended the annual business meeting the next morning, which was announced as an open forum for discussion by members. Only 1 member rose to suggest or criticize. The rest confined their activities to clapping when the reports for the year were read.

It was announced that 1,870 votes were cast for president, of which 1,863 were for the nominee of the Board of Directors. The other officers elected also got 1,800 and some odd votes each. This indicates that three-quarters of the members consigned their ballots to the waste basket. This suggests that three-quarters of the Institute members have an intelligence by which the Institute might profit.

There were 40 members at the annual open forum. About 400 partook of the free lunch that day.

Lincoln was a great man. We revere him and take off our hats when we stand before his statue. Lincoln said in his Gettysburg speech that "government for the people, of the people, and by the people shall not perish from the earth."

How out of place Lincoln would have felt in the American Institute!

The engineers say of themselves that they could run the country better than any other group.

The Institute has lost over a thousand members in the last two years.

The Prospecting Complex

THE SEARCH, not the finding, they say, is what lures the prospector. And in that he is like the rest of us: anticipation is generally more sweet than realization. In his story, "Memoirs of a Master Promoter," George L. (alias "Tex") Rickard describes the psychology of the genuine prospector in two short paragraphs better than most people could do it in as many chapters. Rickard established the first bar and gambling house in Nome, Alaska. He ran it for four years, leaving not long after it was discovered that the beach sands contained the yellow metal that the miners had been digging in the interior. He says:

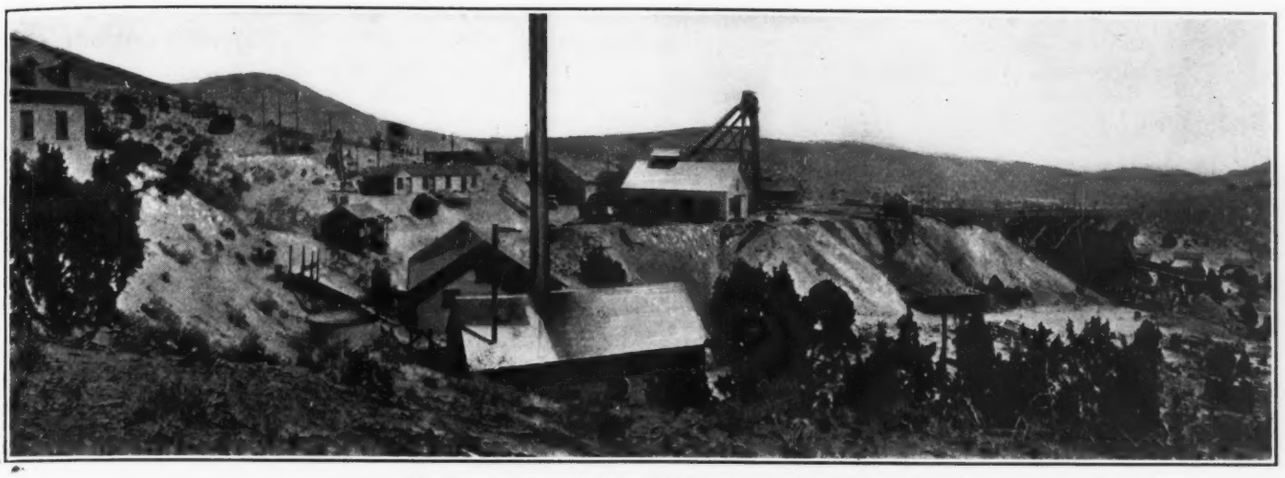
"I hope I haven't created the impression that the men who dug out all this gold got away from the Yukon with it. On the contrary, they rarely went out with anything. The bulk of it went into the general development of Alaska. When a man made a strike he would usually put his profits right back in the ground, buying other claims that didn't pan out.

"I have said that I made close to $500,000. I never had that much at once. Just like the other prospectors, I would trade in claims. There was nothing else to do with the gold. There was no fun in seeing it piled up in the safe. We had to have some kind of action."

Yes, that is the secret of it all: Action! And that is why we seldom hear of a prospector who has much to leave behind when he finally crosses the Great Divide.

Journal-Press Platinum Quotations

THE IMPORTANCE of the major non-ferrous metal markets is apt to overshadow the attention that is given by some of our readers to the minor metal prices, but now and then we hear from some reader who informs us that he is using a minor metal quotation for settlement purposes in the buying or selling of a particular metal. This seems to be more and more the custom in the platinum market, or the metals of the platinum group. Some of the largest producers and dealers have been using our platinum quotations in sales contracts, according to statements made to us. Although this is naturally a source of gratification as reflecting confidence in our methods, it places a responsibility upon our shoulders which we are anxious to discharge as capably as it is possible to do so. Fortunately, we are enjoying the cordial co-operation of the largest factors in the platinum market—banks, producers, importers and dealers—so that the task does not suffer from lack of adequate information. In fact, there is no reason therefore why the market should not be quoted accurately—which is all that our readers and ourselves want.



Surface plant at the Tintic Standard mine

Mining Camps of North America

Tintic, Utah: Active Since 1870

Most Productive Silver District in the United States

By H. E. Havenor
Consulting Geologist, Salt Lake City, Utah

H. E. Havenor

THE TINTIC MINING DISTRICT, situated about 85 miles southwesterly from Salt Lake City, Utah, lies in both Juab and Utah counties and includes the towns of Eureka, Mammoth, Silver City, Dividend, and Diamond, the latter now deserted. The first location was made in 1869, and in 1870 an area of 15 square miles, including the eastern part of the area, more generally known as East Tintic, was described by the organizers as the extent of the district.

Tintic is essentially a producer of silver and lead. It is the largest silver producing district in the United States. However, large amounts of gold and copper and some zinc have added materially to the total production valued at $235,000,000. Since discovery of the district, twenty-six mines have yielded dividends totaling approximately $35,000,000. In 1921 and 1922 ore production was at the rate of approximately 8,000 cars annually, or about 400,000 tons. Over 50 per cent of the total came from the Chief Consolidated and Tintic Standard properties.

The Los Angeles & Salt Lake R.R. enters the camp from Tintic valley on the west and the Denver & Rio Grande enters from Goshen valley on the east. The Goshen Valley railway operates from Pearl, a station on the Denver & Rio Grande, to Dividend. A narrow-gage railroad transports ore from the Knight properties to the mill and railroads at Silver City. The Utah Ore Sampling Co. conducts a sampler at Silver City.

All of the towns in the district have the same freight rate on various classes of ore to the smelters at Midvale, Murray, Garfield, and International. Since Salt Lake City is the largest smelting center in the United States, the output of the district, which consists of a great variety of ores, has a ready market, with a relatively low freight rate as compared with many districts at longer distances from smelting centers.

Conditions today are decidedly different from those fifteen years ago. Formerly there were a large number of claim owners and a correspondingly large number of mining companies which were operating in all parts of the district, the greater number probably being outside of known producing areas. These enterprises were usually financed from stock sales and subsequent assessments, and their contribution to the district was the finding of many producers. This method of financing naturally gave rise to the great amount of speculation which has always existed in shares of the Tintic mining companies.

Small Operations Have Been Absorbed

The growth of the Chief Consolidated and Tintic Standard mining companies, following the expansion of activities of the Knight interests, has, within the last few years, resulted in the acquisition of properties chiefly by these companies to such an extent that there are now practically no small operators in possession of mining ground contiguous to producing mines. This condition therefore places the development of the camp in the hands of a small number of operators who have acquired the properties nearest to known ore, and the outlying properties are operating in unproved territory. Development in the future by the large companies may

be more scientific and more efficient, but will probably be less speculative, and therefore of more interest to mining operators and of less interest to the public.

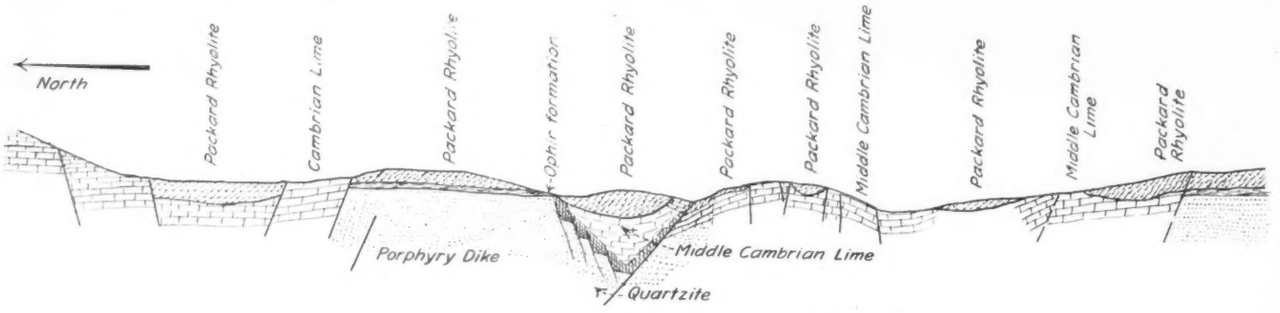
It is doubtless true that geologic knowledge as a rule has followed rather than led mine discovery. This was partly because a comparatively small amount of this kind of work was done until the last ten years and partly because of the type of ore deposits, chiefly replacement deposits in limestone. This condition is, however, being reversed, and geological work is considered of great importance in the district, the function of the geologist generally being to work out the structural geology and the location of the beds which have been found productive. The mining departments then prospect these beds, either on contract, company account, or through lessees. Many of these have "the nose for ore" and follow leads into new horizons as well as those which have been demonstrated, and, in some cases, have found large orebodies in horizons not previously productive.

In a broad way, the geology of the district is quite clear, but the detail is complicated. Picture, if you will, a syncline of sedimentary rocks striking a little west of north, the west limb dipping from 65 deg. to vertical and in places slightly overturned, exposing in order, quartzite, shale, and a great thickness of limestone. This syncline is unsymmetrical, with relatively flat beds on the east side, which probably merge into an anticlinal fold beyond the developed areas. Only the lower formations are present in East Tintic. A monzonite stock cuts this syncline in the Silver City area, and the contact is, broadly speaking, between Silver City and Mammoth. Swansea rhyolite, an intrusive, is present in the western part of Silver City. Dikes extend from these and perhaps other intrusives into the sedimentaries. The entire area is, for the greater part, covered by one or more lava flows.

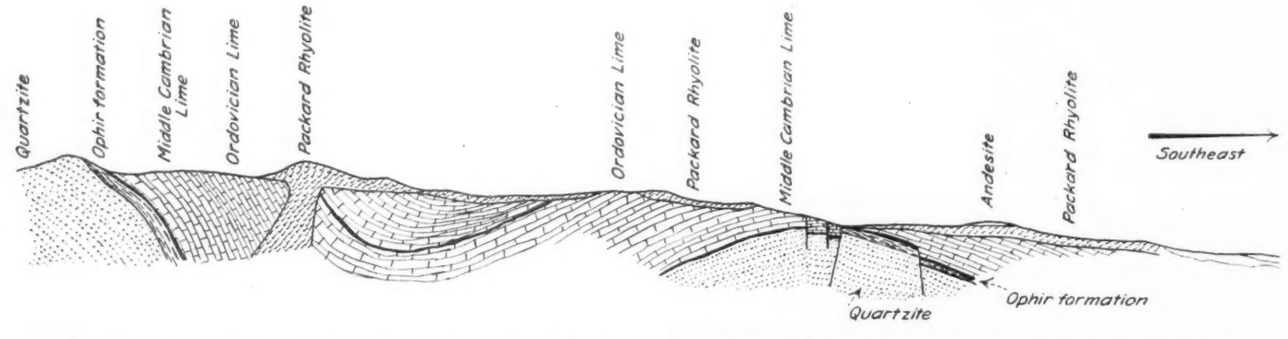
The sedimentaries range from Cambrian and possibly pre-Cambrian to upper-Mississippian. A great amount of erosion took place before the lava flows; therefore in the area so covered there is nothing tangible on which to base an opinion as to the depth of the sedimentaries below. This is one of the unsatisfactory features in the development of properties on the east side. Ore deposits of East Tintic are in the lower horizons; those on the west side are in limestone stratigraphically far above. A great part of the mineralization was probably after the lava flows, and evidence of such mineralization is determined by certain rock alterations. There were probably three or more intrusive centers in the district. The intrusives consist chiefly of monzonite, rhyolites, andesite, latite, and basalt. Some of these are extrusive as well.

There are great transverse faults in the sedimentaries, and in many places they have had a tendency to localize ore deposits at intersections with favorable beds. Other faults are numerous and strike in many directions. Brecciation is pronounced. As a result of folding, faulting, and the entrance of intrusives, the structure is too complicated to warrant an attempt at detailed description in this article. Enough has been shown, perhaps, to substantiate the statement that the biggest producers in the camp today have been "developed" rather than "discovered."

The first locations in the district were made on fissures in the intrusives near Silver City and Diamond. Many small mines were worked down to the water level, which is usually from 150 to 300 ft. deep in that section. There were two dividend-paying mines in the Swansea rhyolite. Leasers are still operating some of these older properties, a great number of which have come under the control of the Tintic Drain Tunnel Co., a Knight corporation which was organized for the purpose of draining the intrusive area and prospecting a large territory on the east side of the Silver City monzonite, which is generally considered as the intrusive



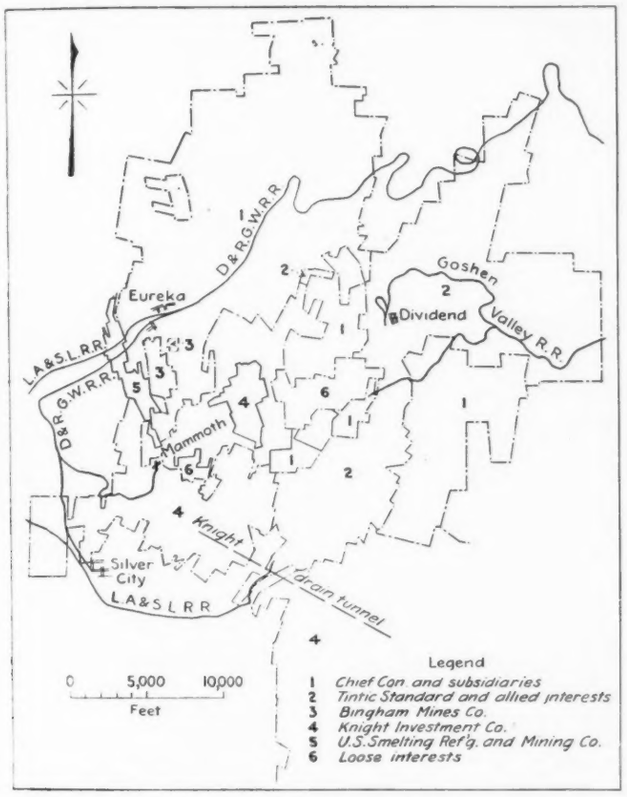
North-south geologic section of a portion of East Tintic



Northwest geologic section from North Tintic to East Tintic (adapted from U. S. Geological Survey)

responsible for a great part of the mineralization of the district. In addition, it is considered that the tunnel will furnish an outlet for the water from the deep mines of the limestone areas. The Drain Tunnel company controls a large amount of arid land near the mouth of the tunnel; it has completed over 6,700 ft. of the projected length of 5 miles and is still in lava flows.

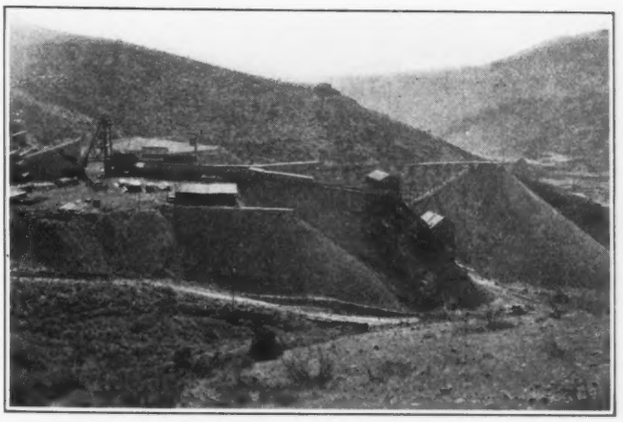
Prospecting in the limestone areas north of the Silver City monzonite followed mining in the fissures heretofore mentioned. Some ore was found on the surface of such properties as the Mammoth, Centennial-Eureka, Eureka Hill, and others. Mining operations proved that there was more ore and better ore north of the contact than at the contact, although several properties along and near the contact made creditable production. It was found that ore in the limestone on the west side



Property map of the Tintic district, showing ownership by the principal companies

seemed to follow certain channels, and therefore most companies sought to prospect these channels. The ore is not continuous, but the stopes "line up" on a general strike. Whether or not the strike of the limestone beds determines the position of the channels has not been clearly demonstrated. Several geologists have worked out a theory of lateral deposition of the ores from the intrusives on the south, substantiating the theory by pointing to the change in the character of the ore as the solutions traveled northward. On the south end of the channels the values are chiefly gold and copper in a heavy siliceous gangue. In the northern parts there is as a rule a silver-lead ore with practically no gold. Between, the values vary.

During the time that these mines were being opened in the limestone on the west side, some smaller properties had been found along a channel about a mile to the east. Among these were the Utah Con., Sioux,



Surface plant and dumps at the Eagle & Blue Bell mine

Carisa, McHatton, Victor, and Dragon Con. Claims were staked all over the district and there were probably more small companies prospecting than producing. Prospecting has always been carried on in near-by areas and on the outskirts of the camp as well, with the result that about the time one mine was depleted a new one became a producer.

The real expansion of the camp started about twenty-five years ago when Jesse Knight went over on Godiva Mountain, cut through solid limestone and opened the Humbug. Several dividend-paying properties were developed in that vicinity, and then, in 1906, Mr. Knight found a big deposit of lead-silver carbonates at a shallow depth in the Beck Tunnel property. This was the discovery of an ore channel which was followed south through the Colorado, Sioux and Iron Blossom properties for more than a mile. It has paid over $6,000,000 to stockholders in the companies mentioned and is still productive. The ore is in replacement deposits on the northern part and a fissure deposit on the southern end.

The Knight interests organized many companies and acquired others. They took dormant properties around Mammoth and organized the Empire Mines Co., making a property of large area extending to their holdings on the Iron Blossom ore channel. They also acquired contiguous ground. This was probably the first definite move for the ownership of large acreage in the district. The Knight Investment company built a custom mill to handle the low-grade silver ore from its mines and from other properties and constructed a narrow-gage railroad to transport the ore to the mill at Silver City. Subsequently the Tintic Drain Tunnel Co. was organized and many claims were located along its course.

Iron Blossom shaft

Gemini Chief Consolidated

Eureka, Utah. This district has produced more silver

In the meantime, Walter Fitch, Sr., had been making a study of the west side of the district. He believed that ore channels, other than those already developed, existed, and consequently he secured the Little Chief property and added some contiguous ground to his holdings. The Little Chief was a stock company which had been assessed many times and did not show commercial ore. This was reorganized into the Chief Consolidated Mining Co., and after spending nearly $300,000 Mr. Fitch found what he was seeking. His company later bought the underground rights of Eureka townsite and proceeded to make a geological study of the district.

As a result, other properties were purchased and many locations were made. Adjoining mines were taken over and equipment was changed. Mr. Fitch adopted new mining policies and new methods, and today is the biggest factor in the camp. His company controls more than 11,000 acres of land, including the Grand Central, Eureka Hill, and Gemini mines, which before their acquisition paid in dividends a total of $6,315,000. The Chief Consolidated has diamond drilled and churn drilled in many places of the district. It has extended its holdings to the east side and to the north; is doing more development work than all of the other mines in the district combined, and is adding to its income by the production of limestone from one of the finest quarries in the state. In a short time its total production will be 1,000,000 tons of ore. Dividends paid to date amount to over $2,600,000. Mr. Fitch is a believer in Tintic and is ably assisted by his son Cecil Fitch, who is manager of the company.

Between the Chief Consolidated and the Grand Central mines are the Eagle & Blue Bell and Victoria properties. These are controlled by the Bingham Mines Co., of which Imer Pett is the general manager. Like Mr. Fitch, Mr. Pett believes in intensive development work, and he has developed in his properties extensive ore channels. The proceeds from these two mines have been a great factor in the earnings of the Bingham Mines Co., which has properties in Bingham as well. The American Star mine is owned by the Bingham Mines. It is situated north of the Eagle & Blue Bell and is surrounded by Chief Consolidated ground. This property has been under development for several years, and in 1922 became a producer. Regular shipments are being made, and there is reason to believe that it will develop into a substantial property. The Bingham Mines Co. also owns the Tesora, in the Silver City intrusive area.

Tintic Standard Has Paid $2,500,000

About 1907 E. J. Raddatz came to Tintic. He had faith in the east side. Three miles east of Eureka he spent about $275,000 raised through stock sales and assessments. This covered a period of nine years filled with almost unsurmountable difficulties. Money was hard to get; and the lower workings encountered carbon dioxide gas in such quantity that work had to be suspended in cloudy or windy weather. In addition, the mine was hot, the rock temperature averaging around 100 deg. Ventilating problems had to be solved and numerous other difficulties overcome. In 1916 the ore was found. Even then, so little faith was shown in that section that it was with great difficulty that arrangements were made for the financing of a new shaft which was necessary for ventilation and cheaper mining. Since that time, this mine, the Tintic Standard, has paid nearly $2,500,000 in dividends, built 12 miles of railroad and a 225-ton mill. Its total output aggregates $15,000,000. Mr. Raddatz and allied interests have acquired an undeveloped acreage second only to that of the Chief Consolidated. The Tintic Standard Mining Co. has built the town of Dividend and has established one of most successful enterprises in the state, and by reason of its establishment has given hope that East Tintic may in time show a production comparable to that of the west side.

Eagle & Blue Bell Eureka Hill Centennial Eureka

silver than any other in the United States

Following the discovery of the Tintic Standard mine, prospecting became active on the east side and many companies were organized for development purposes. In the seven years which have elapsed, no new mines have reached the production stage, but many of these companies, as well as companies which existed prior to that time, have passed into the control of the Chief Consolidated and Tintic Standard interests. Therefore there are few companies operating in East Tintic close to producers.

Large Area Remains for Development

The Chief Consolidated, Tintic Standard, Knight estate, Bingham Mines, United States Smelting, Refining & Mining Co., together with the McIntyre and Loose interests, practically control the proved part of the district. The individual operator must develop ground distant from known areas, and as it is a difficult matter to find ore within the known areas, just how much work will be done in the outlying sections is problematical. Enough work has been done on the east side to warrant the assumption that certain areas there should be developed. This is also probably true of some sections in the northern part of the district. In North Tintic and East Tintic a few small mining companies are prospecting, but their finances are so inadequate that it may be reasonably concluded that future development must largely lie in the hands of the companies above named. It may also be reasonably concluded that the policies of the Chief Consolidated and Tintic Standard mining companies will be those on which the future of the camp largely depends.

A large part of the production of the district is mined under leasing systems, which are here more highly developed perhaps than in any other western mining camp. The success of this system is due to the nature of the ore deposits as well as the profit to be made by lessees when new orebodies are found. The mining companies as a rule lease blocks of ground 100 ft. square by 100 ft. high, usually protecting the lessee by an adjoining block when he is working in virgin territory. Under this system the companies consider that each lessee is his own superintendent and by intimate contact with his block of ground he is able to give it more thorough study than could be possible under company operations. Maps are at the disposal of lessees and the companies furnish supplies at or near cost. In likely places, the lessee is sometimes paid a stipulated sum for drifting or raising, thus being enabled to earn while prospecting. Royalties range from 20 per cent to 95 per cent, depending on the grade of the ore. In the Chief Consolidated mine, large stopes are worked on a "community" lease whereby the men receive a certain wage and 3 per cent of the net profits of the stope. Many miners in the district have become independent through leasing and a great number of engineers are following this vocation. It is claimed that under this system, the ore is mined cleaner, there is a greater percentage of extraction, that a greater number of orebodies are discovered, and that employees are more satisfied and efficient than under company operations.

Mining Done Through Shafts

Mining methods are very similar to those in other limestone districts. On the west side, stopes are filled with waste from prospect drifts, although in a great many places, timbering or filling is not necessary. Practically all of the mining is done through shafts, and levels are usually made at 100-ft. intervals. The west side properties have reached water level, but the Chief Consolidated is the only one which is pumping. Water from this mine is pumped into a cave on the 1,600 level.

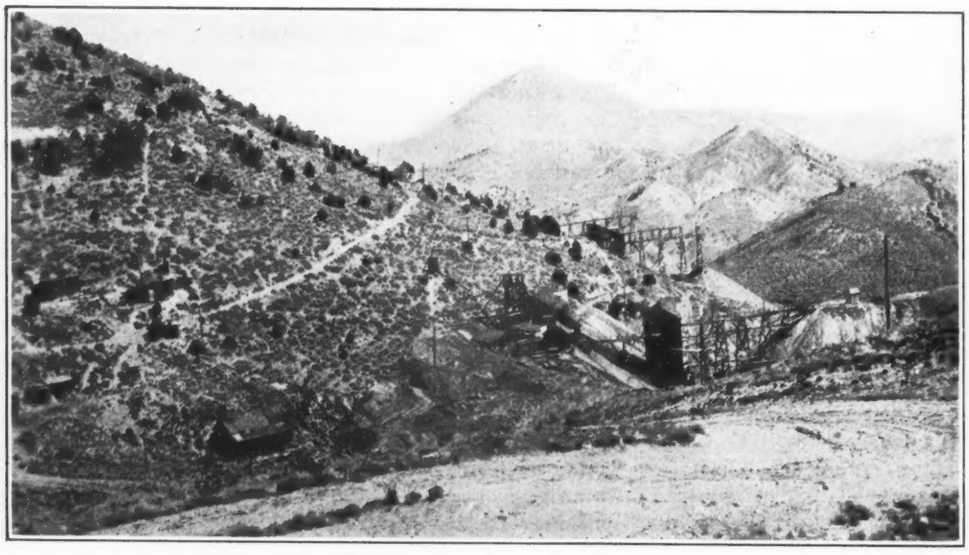
Utah Lake is only a short distance from the district, and it has been held that the level of Utah Lake controlled the water level of the Tintic mines. As Utah Lake is a catchment basin for the water from near-by

mountain ranges, I do not see how this can be the fact, especially as the Tintic Standard mine, three miles or so closer to the lake, is dry at the 1,450 level, which

Beck shaft, looking north on the east slope of Godiva Mountain

is more than 100 ft. below the water level in some of the Eureka properties.

In the Tintic Standard mine, orebodies are so large



Sioux Consolidated shaft

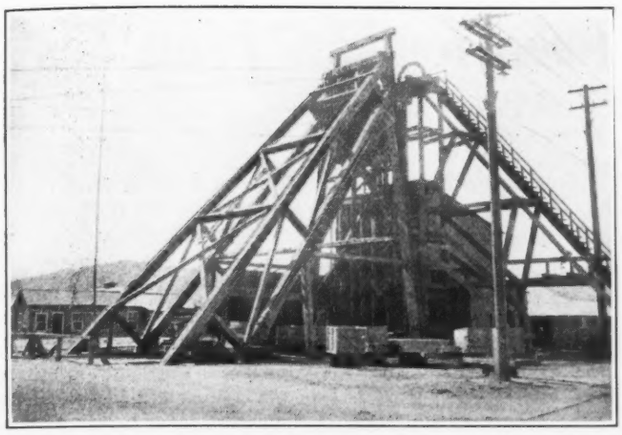
that filling is required, especially as many of the stopes have a shale back. The company is extracting about 400 tons daily, and naturally the development work could not furnish enough waste for filling. This situation has been worked out carefully by James W. Wade, assistant manager. To solve the problem he opened a large quarry on the surface and contracted for the breaking and delivery of rock at the collar of the shaft. This rock is sent down the mine and trammed to the stopes, which are close at hand.

Ventilation Important Problem on East Side

Mine ventilation is an important part of mining operations on the east side. An average shaft passes through lava flows into limestone and then through the Ophir formation, which consists of shale with some limestone beds. Under the Ophir formation is quartzite. This quartzite is badly fractured and filled with carbon dioxide and nitrogen gases. Naturally the overlying shale has to some extent prevented the circulation of these gases, since they are more abundant in quartzite areas, so that some means must be devised to furnish air for the miners. Experiments for a long period in a property with one entry demonstrated that the best way to ventilate was to dilute the gases by blowing air from the surface. The Tintic Standard mine has two shafts, connected on two levels. Air from the surface is introduced through No. 2 shaft and distributed by blowers to working faces. In long drifts, booster fans are used. No. 1 shaft has fans pulling the air from the No. 2 workings and discharging into the shaft. A property with one entry must carry large air pipes from the surface.

The ore of Tintic is not uniform in character or grade. It is practically all siliceous, and as a rule is classed as silver ore, lead-silver, copper, gold-copper, gold-silver, or gold. Large amounts of ore which were not profitable before the war were shipped when silver and lead were selling at high prices. Even now there are large developed tonnages which are not worth shipping as smelting ore at present metal prices. The Tintic Milling Co.'s plant at Silver City is now closed, but when in operation it paid for 80 per cent of the silver, all of the copper, and 30 per cent of the gold. It cannot treat an ore which carries gold or lead as the dominating metal. The Tintic Standard Mining Co. has a similar plant at Harold, in Goshen valley about 9 miles from the mine, and is treating its own low-grade ores, which are low in gold and carry perhaps 4 per cent lead.

The process used consists of a chloridizing roast followed by leaching, copper being precipitated by iron and silver by copper. The mill at Harold is saving some of the lead by precipitation on sponge iron. Though such a mill can handle some of the ores in Eureka and Mammoth, it cannot handle all, and in the mining of the Tintic properties where there are diversified ores, oxide and sulphide, lead, silver, gold and copper values, it is necessary to have a mill which can recover the various



Main shaft of the Chief Consolidated company's mines

metals from the mixed ores as they come from the mines. Large amounts of money have been expended in this metallurgical problem, but mine operators have not been satisfied with processes which have been tried.

After much experimental work the Chief Consolidated Mining Co. has demonstrated that a combination of concentration, flotation and volatilization will solve the problem. The company has announced that it will erect a mill using these processes. This will be an important development for the district, in that it will give employment to many miners and will make profitable large quantities of low-grade ore. Extraction of mill ore in the Tintic mines has usually resulted in the development of shipping ore in close proximity.

Tintic at this time finds itself in good condition, although there are not as many men employed as when the Pittman Act was in effect. Most of the companies built large treasuries during the period of dollar silver and fortified themselves against the depression that followed. The Tintic Standard is increasing its forces, and the Chief Consolidated is again expanding, although there was some curtailment when silver dropped. The lead market is firm and present prices enable a large tonnage to be profitably mined. Prospecting companies are not so active as during the war, but several properties are being continuously developed.

Labor Troubles Have Been Few

A great part of the miners live in their own homes. Labor agitators as a rule are not welcome. Strikes have been few, for the residents are nearly all engaged in leasing. Wages range from $4.50 to $5.25. A bonus system is in effect on some work. Each mining company has signified its willingness to meet with its men on any questions which arise.

And now—the future of Tintic. Production must come from undeveloped sections and the lower levels of the older mines, new horizons, new mines. Tintic is about fifty-four years old, but new possibilities are noted as knowledge of ore deposits is increased. The method of future development lies largely with the operating companies, and although prospecting may be curtailed from time to time, it is reasonable to expect that ore discovery will continue, both within and without known producing areas and that as a result Tintic will continue to be a substantial producer for many years.

There is a reasonable expectation that new mines will be opened in East Tintic. North Tintic is as yet undeveloped. The sedimentary areas south of the Silver City intrusives are practically untouched. A large number of undeveloped claims lie between the known orebodies of Eureka and East Tintic. It is probable that mining operations will be carried on for years in these sections.

It is safe to say that the average engineer or operator who knows Tintic would rather spend money looking for ore in this district than following it in many of the small camps in the West. The metallurgist has his problem in the extraction of metals from the complex ores; but more efficient processes will increase production. In the meantime, exploration is being continued by the operating companies, and the production of the camp is being maintained.

Petroleum Industry in Japan

The amalgamation of the Nippon Kerosene Co. and the Hoden Oil Co., followed by an amalgamation of the Asahi Oil Co. and the Teikoku Oil Co. was consummated in 1922, and, also, a union of the minor oil manufacturers in the Niigata Prefecture was effected, in order to form a sales organization. The Ogura Oil Refining Co., as well as several other companies, began to import foreign oil, a recent report of the Tokio Chamber of Commerce states, with the object of refining it for the Japanese market. Foreign oil was imported in such a great quantity as to cause a decided oversupply in the market.

Except during seasons of demand, when quotations experience a slight fluctuation, the oil market condition in Japan had usually been steady, but the market of 1922 was greatly unsettled, owing to the activities of the domestic companies which refined the crude oil imported into Japan. This, it is claimed, caused the union of the Nippon Oil Co., the Standard Oil Co. and the Rising Sun Oil Co. to lose effectiveness and made them unable to keep pace in their activities. The three companies declared that the union still existed and that the price of light oil and lamp oil would be enhanced by 20 sen per case at the beginning of November, 1922. But in reality the selling price was reduced lower than the price before their declaration. Under such circumstances some minor oil companies were said to be on the verge of bankruptcy.

In the latter months of 1922 crude oil declined greatly, falling 39.5 per cent, and light oil declined 34.2 per cent and machine oil 20 per cent. The demand for lamp oil decreased heavily because of the growing use of gas or electric light, and even other kinds of oils actually proved to be in small demand, as the consumers took precaution not to order more than enough for their needs for a short time so as to be ready to take advantage of further declines.

Japan's oil production falls far short of her own consumption and she finds it necessary to import from America and the Dutch Indies. Each kind of oil, according to statistics, has been on the decrease, in imports, since 1912, but in the last few years the volume has assumed a tendency to increase, although it has not reached the level of pre-war days. Crude oil has begun to be imported in such a great volume that it amounts to three times the volume imported in 1914. This fact accounts for the great improvement in the oil-refining industry of Japan.

Sodium Sulphide and Classification Troubles

By G. E. Stowell
Mill Superintendent, Beaver Gold Mining Co., Granite, Oregon

G. E. Stowell

THE new flotation mill of the Beaver Gold Mining Co. was started last September. The company operates the Buffalo Monitor mine near Granite, Grant County, Ore.; ships high-grade crude ore and mills the lower-grade ore. The mill is designed for one-man operation per shift except in crushing the ore and drying the concentrates. A 5x4-ft. Hines ball mill operates in closed circuit with a 30-in. Akins classifier, the classifier overflow going to a 6-cell rougher and a 3-cell cleaner Pachuca-type flotation machine and the tailing passing over a 6-ft. Isbell pilot vanner.

The valuable minerals are gold and silver associated mainly with pyrite and arsenopyrite in quartz. Galena, sphalerite, stibnite, pyrargyrite, tetrahedrite, and chalcopyrite are present in small amounts. The ore is generally quite variable—hard, clean, siliceous at times, and again soft, altered vein filling, or a mixture of the two. Oxidation is apparent in nearly all ore mined within 200 ft. of the surface. Sodium sulphide is used, 1 lb. to 3 lb. per ton of ore, to aid in floating the more or less oxidized pyrite; it also helps to control the froth.

Upon starting the mill, classification was erratic and in consequence flotation was difficult to control and recovery indifferent. This was especially true on runs of siliceous ore containing a minimum of primary slime. At such times, one of the two following conditions would prevail in the classifier: (1) The classifier overflow would be extremely fine, practically all 200 mesh, and by no possible adjustment of grade or water could coarse sand be made to overflow. The ball mill would soon overload, making it necessary to reduce the feed. The classifier grade was greatly increased and finally "shovel flights" were added to that portion of the spiral operating in the bath, in an effort to agitate the pulp and raise the sand to the overflow weir, but to no avail. (2) The coarse sand, instead of being carried up-grade and returned to the ball mill, would in part work downward against the action of the helix, finally filling the bath and overflowing coarse unclassified material. Corrective measures tried were reduction of grade and increase of helix speed from 6 r.p.m. to 8 r.p.m. and finally to 12 r.p.m. The increase in speed helped in some degree but did not eliminate the trouble.

At this time the amount of sodium sulphide used was approximately 1 lb. per ton of ore, fed through the ball mill in the belief that the reagent, by reason of longer contact with the ore, would then be most effective. It was noted on several occasions that, when for some reason the sodium sulphide was materially increased or decreased, conditions on the classifier would change, and thus suspicion became centered on the reagent as the probable cause of trouble. The sulphide solution box was then changed to the head of the rougher cells with the result that within a few minutes the classifier was doing normal consistent work. Classification difficulties as such have been absent since that date.

Later, the following test was made and rechecked to prove the accuracy of the observation: The ore being milled was average siliceous material containing but a small amount of primary slime. The classifier grade was set at 2 in. per foot and the helix speed 12 r.p.m. The ball-mill circuit was free from sodium sulphide and the classifier overflow showed normal grinding. A sizing sample of the overflow was taken and then sufficient sodium sulphide added to the scoop box to sulphidize the circuit. In three minutes the darkened color of the pulp on the classifier bath indicated the effect of the reagent; screening showed that coarse sand had disappeared from the overflow and a second sample was taken. Sizing of the samples was as follows:

	Normal Classification No sodium sulphide		Sodium Sulphide After 3 minutes	
	Individual Per Cent	Cumulative Per Cent	Individual Per Cent	Cumulative Per Cent
On 60 mesh	11.0	11.0	0.0	0.0
100 mesh	12.9	23.9	1.4	1.4
150 mesh	6.2	30.1	3.7	5.1
200 mesh	5.4	35.5	3.8	8.9
Through 200 mesh	64.5	100.0	91.1	100.0

At the 8-minute period coarse sand was in evidence in the classifier bath and at 20 minutes the bath was entirely filled, unclassified pulp overflowing the discharge weir. Gradually the reagent worked out of the circuit with reversal of conditions.

Incidentally, the removal of the sodium sulphide from the ball mill has not impaired extraction, and it has developed that under the same given conditions flotation concentrates are lower in "insoluble" matter and consequently of higher grade than when the reagent is fed to the ball mill. Apparently the flotability of gangue minerals is increased by too long contact of ore with reagent.

My conclusions are:

(1) Sodium sulphide, when fed into the ball-mill classifier circuit, may cause erratic classification, especially on ores containing little or no primary slime. With slimy ores the reagent probably would have very little effect, as the slime present would enable the operator to keep sufficient pulp density on the classifier to discharge sand of any desired degree of coarseness.

(2) The effect of the reagent is probably due to its deflocculating action on slime (hydrolysis of Na_2S produces NaOH in solution). If this conclusion be true, other active deflocculents might give similar action.

(3) The addition of the reagent to the ball mill probably would not give special benefit in the majority of cases so far as flotation results are concerned. If, however, the opposite be true, means may be taken to nullify the action of the reagent on the classifier, as by mixing slimy and clean ores; by operation of the ball mill to produce a greater proportion of slime; and by addition of a small portion of the reagent to the ball mill with the remainder fed direct to the flotation cells.

Some Kata-thermometer Observations in Tonopah Mines

By Robert S. Lewis
Professor of Mining, University of Utah, Salt Lake City, Utah

Robert S. Lewis

THE mining town of Tonopah, Nevada, (elevation 6,000 ft.) is in a desert country where the air in summer is unusually dry. Ore was discovered in 1900, and in 1920 Tonopah had a population of approximately 5,000. The population is now below this figure owing to the closing of some of the mines. The Tonopah Belmont Development Co. has recently stopped operations, as the small quantity of ore remaining in the mine could not be profitably mined, because of the high cost of labor and the lower price of silver. This company, capitalized at 1,500,000 shares of $1 par value, has paid a total in dividends, beginning in 1906 and ending April 2, 1923, of $10,793,063.32. The mine has more than 41 miles of drifts, raises, and crosscuts.

Recent development of bodies of good ore in the West End Consolidated and Tonopah Extension mines indicate that these mines will continue to operate for several years. The West End is producing about 250 tons of ore a day and the Tonopah Extension about 400 tons a day.

Records of the U. S. Weather Bureau station at Tonopah show that the average humidity for the last sixteen years is 29 per cent. The average humidity for the first eleven days of July 1923, were as follows:

4:40 a.m.	Noon	4:40 p.m.
27.6%	18%	14.1%

The relative humidity changes greatly during the day, so that readings as low as 7 or 8 or even 6 per cent are not uncommon.

Natural ventilation only has been used in the mines. As the depth of working increased it became necessary, in some cases, to use small fans and either galvanized-iron pipe or canvas tubing to convey air to the working face of drifts and stopes where the natural circulation of air was poor.

In some of the mines warm water, 94 to 96 deg. F., has been found on the lowest levels. The Tonopah Extension Mining Co. drives diamond-drill holes ahead of drifts to tap any pockets of water that may be found. Pumping is an item of considerable expense, but it seems to lower the water level, so that the quantity of water to be pumped may become less rather than greater, unless new underground reservoirs are tapped. The water makes the air warm and humid. Wherever men work under such conditions they perspire freely, if working only at a moderate rate, though they are stripped to the waist. Until recently the emphasis in mine ventilation has been placed on the purity of the air and little attention has been paid to the cooling effect of moving air and the consequent increase in the efficiency of the miner because of improved working conditions. Warmth, humidity, and stillness of air have a marked effect in lowering the efficiency of miners. Men can work for only a short time and then must stop work to cool off. R. R. Sayers and D. Harrington (*Engineering and Mining Journal*, Aug. 28, 1920), have stated the effects on the human system of still air in metal mines where the wet-bulb temperature was over 90 deg. F. and under 100 deg., and with relative humidity of 89 per cent or over, even when little or no exercise was taken:

1. Blood pressure fell rapidly.
2. Body temperature rose. In one case to 102 deg. F. after less than two hours in the place.
3. Pulse rate increased and seemed more sensitive to exercise than normally.
4. Perspiration was very profuse.
5. Dizziness was a common symptom and sometimes was very marked.
6. Physical weakness or exhaustion was marked in some cases, and present in all.
7. Nausea was occasionally noted.
8. Headache was occasionally produced.
9. Inability to think quickly or act accurately was a common symptom.
10. Loss in weight was very marked in men who had worked under bad conditions for several years and was noted after exposure for only a few days.

In still air with wet-bulb temperature 85 to 86 deg. F. and relative humidity of 96 per cent, there was no marked changes in blood pressure or body temperature, nor were the dizziness, physical weakness, and inability to think quickly found while resting or taking only light exercise.

The cooling effect of moving air is very important. In places where neither the relative humidity nor the temperature of the air can be readily changed the velocity of the ventilating current may be increased and a decidedly greater cooling effect on the miners can thus be secured.

Dr. Leonard Hill has devised an instrument, called the kata-thermometer, for measuring the cooling effect of the air on the human body. This instrument has been described in the *Engineering and Mining Journal* of June 18, 1921, on page 1,029. Other references are: "Ventilation and Human Efficiency," by Leonard Hill, *Mining & Scientific Press*, Feb. 25, 1922 (this is an abstract of an article in Bulletin 205, Institution of Mining and Metallurgy), and "The Kata-thermometer and Its Practical Use in Mining," by H. J. Ireland, in the *Journal of the Chemical, Metallurgical and Mining Society of South Africa*, November, 1920.

Briefly described, the "kata" is like an ordinary thermometer 8½ in. long, but has a bulb about as large as a man's thumb. In the latest type, the stem has only two plain marks etched on the stem about 3½ in. apart. A factor of three figures is also marked on the stem. To make a reading, the "kata" must first be heated until the red column is driven above the

upper mark into the enlargement at the top of the stem. The instrument is then placed where the reading is to be taken, and the time in seconds for the column to fall from the upper to the lower mark is noted with a stop watch. This time divided into the factor gives the kata reading. Thus with a factor of 486 and time of 4 min. and 5 sec., or 245 sec., the kata reading is 486 divided by 245 = 1.9+. The kata is designed to show the cooling effect of the air in millicalories per square centimeter per second on the bulb at body temperature.

Kata-thermometer of the latest type

The cooling effect on the bulb is due to radiation, convection, and evaporation. As the instrument is to be used both wet and dry, a silk net is slipped over the bulb for the wet reading, and after heating the surplus water is shaken off. The dry kata shows the cooling effect due to radiation and convection, the wet kata shows the cooling effect due to radiation, convection, and evaporation; the difference between the two shows the evaporative effect of the air. Thus, the kata-thermometer acts like a sweating man. A convenient way of heating it is to use a thermos bottle containing water at 150 deg. F. The bulb can be slipped into the bottle and the instrument heated quickly. For dry readings, the adhering water should be carefully wiped off the bulb and stem. The cooling effect due to radiation is practically negligible where the air has considerable velocity. Because of its sensitiveness, the kata can be used as an anemometer to determine velocities of air that are less than can be registered by an ordinary anemometer. For the most accurate results from three to five readings should be made in the same place and the average of these results taken.

Dr. Hill has made an extended investigation of ventilating conditions, and, after substantiating his conclusions by medical examinations, has set the following kata standards:

For sedentary occupations	Dry kata 5 to 7	Wet kata 16 to 20
For light manual work	Dry kata 8	Wet kata 25
For heavy manual work	Dry kata 10	Wet kata 30 to 35

Dr. A. J. Orenstein and H. J. Ireland have used the kata to determine the efficiency of miners when at work. In places where the kata reading was 6, the work done was considered 100 per cent. On this basis, the work done where the kata reading was only 1 fell to 50 per cent. It was estimated from observations made through part of the mine that about 21 per cent of the possible output of the mine was lost due to the insufficient cooling power of the air.

After extended discussion, the New Zealand mining engineers (*Mining Magazine*, November, 1922), have set tentative standards of 4 for the dry kata and 10.6 for the wet kata as the minimum for the mines.

The following data show the effect of increasing the velocity of the air in the working places:

Place	Dry Bulb	Wet Bulb	Dry Kata	Wet Kata	Velocity Feet per Second	Conditions
Royal Lode West	88.7	88	1.57	4.9	Stil.	Unendurable
Royal Lode West	88	84.7	4.46	21.8	6 ft.	Good for work
Royal Lode West	87	83	6.3	27.1	11.85	Excessive velocity
Waihi mine, 1,450 level	81.4	80.2	2.9	9.4	Still	Oppressive
Waihi mine, 1,450 level	80.2	78.6	15	33.2	12.9	Excessive velocity

The first three tests were made at the same place. The difference in conditions was due solely to increasing the velocity of the air. Likewise, the last two tests were made at the same spot, the only variable being the air velocity.

The following tabulated data show the conditions in the principal working places of the Belmont, Tonopah Extension, and West End mines:

Observations in Tonopah Belmont Development Co.'s Mine, July 10, 1923

No.	Time a. m.	Place Surface	Dry Bulb, Deg. F.	Wet Bulb, Deg. F.	Relative Humidity, Per Cent	Dry Kata	Wet Kata
1	8:10	Surface	78	50	12	...	...
2	8:35	1,000 level	79.5	76	86	2.6	10.6
3	8:50	1,000 level	83	70.5	90	13.1	44.1
4	9:00	1,000 level	91	88	89	1.1	4.3
5	9:25	1,000 level	84	81.5	91	2.0	7.9
6	9:40	1,000 level	83	78	81	2.0	10.6
7	9:53	1,000 level	84	81	88	3.4	12.0
8	10:00	1,000 level	86	80.5	79.5	1.9	7.8
9	10:25	1,000 level	63	54.5	60.5	7.2	18.4
10	10:35	1,000 level	63	54.5	60.5	10.3	30.4
11	10:45	1,000 level	71.5	59	50	8.5	30.4
12	11:20	1,500 level	85	81	85	4.9	16.7
13	11:40	1,500 level	90	89	96	1.0	6.3

1. At collar of shaft.
2. 10,091 stope second floor. Air blowing from ventilating tube on floor above.
3. 10,091 stope on third floor directly in front of ventilating tube.
4. 10,097 stope, air from 10,091 stope forced to this stope by fan.
5. East Stope 3. Air from 10,091 stope forced to this stope.
6. West side Belmont shaft (upcast). Air coming from Desert Queen shaft (downcast).
7. East side of Belmont shaft. Air coming from stopes in Nos. 2, 3, 4, 5.
8. 100 ft. south of Belmont shaft. Air from same stopes as No. 7.
9. 100 ft. east of Desert Queen shaft. Halfway between shaft and ventilating door, regulator open.
10. Same as No. 9 but with ventilating door wide open, thus creating a strong draft.
11. Air coming from 900 level through open stopes; good draft.
12. Near intake of large fan taking air from 1,300 level.
13. About 150 ft. east of shaft. Air coming from shaft. Conditions oppressive.

Observations at Tonopah Extension Mine, July 9, 1923

No.	Time a.m.	Place	Dry Bulb, Deg. F.	Wet Bulb, Deg. F.	Relative Humidity, Per Cent	Dry Kata	Wet Kata
1	10:00	Surface	76	52	19	...	...
2	10:10	1,200 level	76.5	69	70	...	...
3	10:15	1,200 level	80	76	84	...	...
4	10:50	1,540 level	87	84.5	91	1.5	6.5
5	noon	intermediate	81	75	77	2.4	9.0
6	p.m. 12:20	intermediate	81.5	80.5	96	2.3	7.4
7	12:30	intermediate	82	81	96	1.8	8.1
8	1:00	1,940 level	81.5	79	90	2.4	8.2
9	1:30	1,940 level	86	84.5	94	1.6	5.5
10	1:45	2,000 level	94	93	97	0.5	1.6
11	2:30	Surface	80	50	9	...	...

4. At pump station. Water running into sump 96 deg. F.
5. Large open stope. Not much circulation of air.
6. Square set stope on same level as No. 5. Heavy perspiration produced.
7. Same level as No. 5, one set above level, near end of stope.
8. Square set stope.
9. Same level as No. 8. Large open stope.
10. About 100 ft. from bottom of shaft in drift 725 ft. long, water at 96 deg. F. covers bottom of drift.

Natural ventilation in the Tonopah Extension mine is not satisfactory as the depth of mining increases. The company is working out a system of forced ventilation so that working conditions on the lower levels will be greatly improved. The Cash Boy shaft will be used as a downcast and a large fan will be placed in the mine at the bottom of this shaft. Several small fans are now used underground.

Observations at the West End Consolidated Co. Mine, July 12, 1923

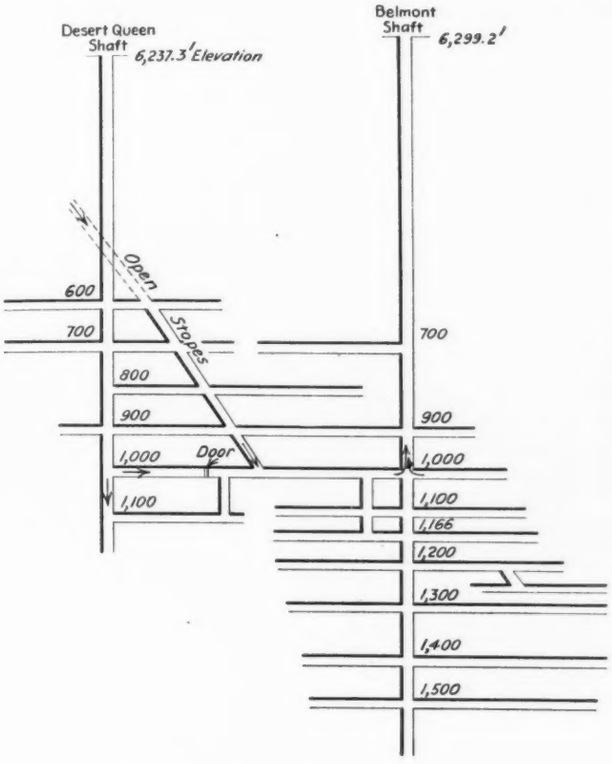
No.	Time a.m.	Place	Dry Bulb Deg. F.	Wet Bulb Deg. F.	Relative Humidity Per Cent	Dry Kata	Wet Kata
1	8:00	Surface	71	54	35	...	...
2	8:20	800 level	80	78	92	2.9	9.5
3	8:30	800 level	76	74	91.5	3.6	10.5
4	8:55	400 level	72	70.5	93	4.0	11.8
5	9:10	400 level	70	68	91	5.2	15.2
6	9:30	500 level	70	69.5	98	3.8	8.9
7	9:50	500 level	72.5	72	98	4.4	11.2
8	10:20	500 level	77.5	75	90	3.4	9.5
9	11:00	Surface	80	55	21	...	...

6. Taken about 50 ft. from Ohio shaft (upcast). Air practically saturated, much fungus on timbers.
7. About 50 ft. above level at top of large open stope 25 to 30 ft. wide, dip about 30 deg.

Ventilation in this mine is by natural circulation only.

Note—The kata-thermometer can be purchased from James J. Hicks, 8, 9 and 10 Hatton Garden, London, E. C., for 18s. 6d.

In interpreting kata-thermometer readings several considerations are to be kept in mind. The kata standards set by Dr. Hill are what might be called ideal conditions, and would be difficult to attain underground, due to the high humidity and high temperature found in most mines. A dry kata reading of 6 and a wet kata reading of 18 have been found to keep native South African workers, who were stripped to the waist, in quite good working condition. (A clothed man is insulated, as it were, and requires a higher kata reading



General scheme Belmont mine vent

than an unclothed man if he is to work as comfortable.) As has been stated, the New Zealand engineers set a dry kata reading at 4 and a wet kata reading of 10.6 as minimum kata standards. These are evidently considered to give reasonable working conditions for a hot mine. However, there is a difference in men, and some miners can do good work where others could not work at all efficiently.

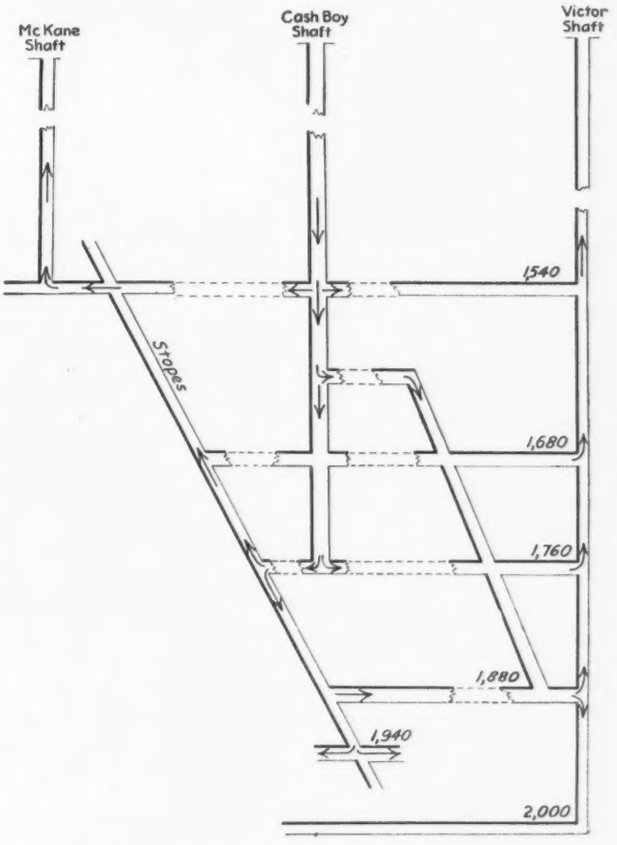
The regulating of ventilating conditions by limiting the wet-bulb temperature has been proposed by several authorities, who have set a wet-bulb limit of from 85 to 80 deg. F. and over, but men have been kept reasonably cool in a wet-bulb temperature of 85 deg. F. —air nearly saturated—by giving the air a velocity of about 6 ft. a second. Due to the cooling effect of the moving air, a man could work under conditions that would be unbearable in still air. Since the kata-thermometer registers the cooling effect of moving air, it is a better measure of ventilating conditions than the common thermometer, which is not affected by air movement.

A high wet-kata reading does not fully offset a low dry-kata reading. Such a condition means that the air is fairly dry and a man must sweat to be cooled. Exercise would induce more perspiration and the high evaporative power of the air would result in greater bodily cooling. If he were still, a man would feel uncomfortable.

The effect on the kata-thermometer of change in velocity of air is well shown in tests 2, 3, and 4; also in tests 9 and 10 of the Belmont mine. In test 3, the kata readings were taken directly in front of the ventilating tube, from which air issued with a velocity of over 2,500 ft. per minute. This air was fairly dry. The velocity would be excessive for working conditions. Test 2 shows conditions in the same stope, but some distance from the end of the ventilating tube. The air movement was scarcely noticeable.

In test 4, the observations were made at the top of a small stope, where conditions were very uncomfortable, owing to the stillness of the air. Sweating, during the taking of the readings, was very profuse. Tests 9 and 10 show how the kata is affected when the velocity is changed, the humidity and temperature of the air remaining the same. Test 9 was made with the ventilating door in the level shut, but a small regulator in the door was open. Test 10 gives the kata readings when the ventilating door was fully opened. Due to the stronger air current the dry reading increased from 7.+ to 10.+ and the wet reading from 18.+ to 30.+. The dryness of the air, about 60 per cent humidity, was due to the air coming down from the surface through dry workings.

In test 12, despite the dry and wet bulb readings of 85 and 81 deg. F., the kata readings were 4.9 and 16.7 because of the high air velocity. Another observation made on the 1,500 level, in the hottest part of the mine and where air circulation was slow, gave a dry-kata



Scheme of natural ventilation, Tonopah Extension Mining Co.

reading of about 1 and a wet reading of 6. The dry bulb was 90 deg., the wet bulb 89 deg. F. The air, being practically saturated, made conditions very oppressive.

The West End mine uses natural ventilation only, and it is one of the coolest mines in the district. The kata readings taken in this mine would be nearly within the New Zealand specifications of 4 and 10.6 for the dry and wet readings respectively.

In the Tonopah Extension mine the lower workings are hot, and kata readings are generally low. An observation on the 2,000 level gave a dry kata reading of much less than 1 (full time was not given, as it was obvious that the reading would be below 1) and a wet reading of 1.6. The air was still and was nearly saturated. Wet bulb was 93 deg. F. Conditions were so oppressive that headache and nausea were usually experienced by those not accustomed to the level. If the wet-bulb reading is higher than body temperature, over 98.5 deg. F., the body will be heated by the air, and increasing the velocity of the air hastens the heating process. In such a circumstance the kata can be cooled below the lower mark and the heating power of the air can be determined by reversing the usual method of observation—that is, by noting the time for the column to rise from the lower to the higher mark on the instrument. The Tonopah Extension company has recognized the need for better mine conditions and the management will soon have a system of mechanical ventilation in operation.

The kata-thermometer, of course, gives no hint as to the purity of the mine air or of the quantity of dust in the atmosphere. However, dry- and wet-bulb thermometers do not either, and, furthermore, they do not show the cooling effect of moving air, a most important consideration in mine ventilation, where neither the humidity nor the temperature can be greatly changed, and the problem is to make the best of the air as it is.

One company is trying out a small fan, like a house fan, that is driven by a specially designed compressed-air motor. This fan can be placed in a stope near miners and the air can be stirred to give a satisfactory cooling effect where it would not pay to increase the speed of the air current by changing the main ventilating system.

Early History of Cyanidation

NO SINGLE INNOVATION in the history of modern chemico-metallurgy has had so great an influence on contemporary technology and world economics as the cyanide process, invented by John Stewart MacArthur and R. W. and W. Forrest, in 1886. In ten years the world output of gold was doubled, mainly because of the introduction of this new process, partly because its economic and technical practicability enabled more ore to be treated by the standard method of amalgamation with mercury, followed by a cheap cyanide treatment of the tailing. Not only was the new process responsible for a revolutionary change in methods of recovering gold and silver, displacing older process that were inefficient and wasteful and costly, or acting in complementary manner with a standard process such as amalgamation, but the need for the treatment by wet chemical methods of every particle of the ore necessitated intensive research on the problem of removing a valuable solution from a colloidal or finely ground gangue or waste. Thus the introduction of the cyanide process was directly responsible for a quickening of scientific initiative that led to the invention and commercial development of vacuum filters, which has had a profound influence on advance in chemical and metallurgical technology, by which an almost infinite number of applications has been made of the original idea.

Moreover, the need arose at an early date in the application of the new process for means whereby the gold ore pulp could be settled and thickened continuously by mechanical means, or agitated effectively by compressed air. Here, again, research and invention by cyanide engineers blazed a trail of success that has simplified operations and cheapened production in many widely different technical industries. Similarly, it was the intense interest manifested for twenty years or so after the first application of the cyanide process that deflected attention to the problems of economical crushing and ore handling.

No development in the history of technology received such wide publicity as did the cyanide process for a quarter of a century after its introduction. Although the quantity of non-refractory porous gold ores available was comparatively small, it was the cyanide process that showed how it was possible to solve the slime problem in some instances by the direct leaching of the entire charge. The successes achieved at the Mercur plant, in Utah, at the Wasp No. 2 mill, in South Dakota, and in other similar applications in Africa and India were significant; and it was only the exhaustion of surface ores that prevented the more extensive use of bulk leaching in the metallurgy of gold. The lessons learnt, however, proved valuable. The immense possibilities of bulk leaching attracted attention in other allied fields of technology. Significant developments have occurred, and the initial idea has suggested intensive research and has led to refinements and economies in the practice of electrometallurgy and chemical engineering.

The tremendous influence that cyanidation has had on contemporary technology justifies the publication of a historical summary of its inception and development throughout the world. The main features and items of interest are within the memory of engineers and chemists in the prime of life today. Death has claimed some of the pioneers—John Stewart MacArthur, Henry Forbes Julian, Philip Argall, and Hennen Jennings, for example. A great deal of information has been published in scattered form; but the process after a brief period of scepticism and opposition, was adopted so widely—in all parts of the earth where gold ore is found—that much of interest and pertinence to early history remains unrecorded. Condensed information of this character will be welcomed by A. W. Allen, assistant editor *Engineering and Mining Journal-Press*, 883 Mission St., San Francisco, Calif., who is preparing a summary for publication in the *Journal-Press*. It is particularly desirable that details of pioneer work and struggles, and early methods of application of the process of extraction and recovery be made available, especially in reference to those countries that have contributed little to published accounts, such as Brazil, Mexico, and Queensland. Care should be taken that names, initials, and dates are correct. The loan of photographs and drawings of early operation will also be appreciated.

Survey of the World's Mineral Resources in the Time of Christ

A Review of Strabo's Geography — Early Mining Methods and Abundant Metal Supplies Yielded Much Treasure — Rivalries Keen

By Sydney H. Ball
Mining Engineer, New York

THE MOST FAMOUS of ancient geographers, Strabo, was born about sixty years before Christ, at Masia, Asia Minor, and died about 24 A.D. He was of good stock, his father being a Roman and his mother being related to the rulers of Pontus. As a youth he attended the schools of the time, studying under well-known lecturers on grammar, rhetoric, and philosophy, and, thereafter, he traveled widely in Greece, Italy, Egypt, and Asia Minor. In writing his geography, which was apparently for the guidance and instruction of Roman officials, he used data gathered in his travels and in addition drew largely on the works of his predecesors, particularly Greeks, and, indeed, the original work was written in that language. The book is well written, relatively concise and free from tiresome details.

Strabo first discusses the general principles of geography at length and reviews the works of his predecessors; he then describes in more or less detail the various countries known at the time—namely, those of most of Europe, northern Africa, and southern and southwestern Asia. The most striking fact disclosed by his frequent references to the mineral wealth of the various countries is that many deposits worked in his forefathers' day were considered exhausted by his own contemporaries. Such were the copper mines near Torre Loppa, Italy; the copper mines near Chalcis, Greece, and the gold mines near Astyra in the Troad, Asia Minor; and regarding the gold placers of the Pactolus River, Lydia, the source of Croesus' wealth, Strabo says, "No gold dust is found at present there" (Vol. II, p. 403[1]). Strabo lists many ancient tyrants and kings whose wealth was derived from the exploitation of mines (Vol. III, p. 66).

Mineral Resources Abundant

Europe was in his time a self-contained continent, and though it imported perfumes and precious stones, it produced "all the useful metals" (Vol. I, p. 192), and Strabo states regarding Spain, (Vol. I, p. 219): "Of metals in fact the whole country of the Iberians is full, although it is not equally fertile and flourishing throughout, especially in those parts where the metals abound. It is seldom that any place is blessed with both these advantages and likewise seldom that the different kinds of metals abound in one small territory." Turdetania (Southwestern Spain), within which is the present Huelva district, was rich in gold, silver, copper, and iron. He elsewhere (Vol. I, p. 214) draws the conclusion, still true in most instances, that "Districts which contain metals must of necessity be rugged and poor." Perhaps the first suggestion of an accumulation of gold at the outcrop of copper orebodies is Strabo's (Vol. I, p. 220) observation that "Certain of the (Spanish) copper mines are called gold mines, which would seem to show that formerly gold was dug from them."

Even in Alexander the Great's time (356-323 B.C.) the mining profession was recognized, for Strabo states that gold and silver mines exist in the mountains of India "according to the testimony of Gorgus, the miner." Apparently this great monarch in his conquest of the East looked to a mining expert for an appraisal of the mineral possibilities of the region traversed. In this connection Xenophon's "Memorabilia of Socrates" (born about 470 B.C.), in discussing the varying valuation of his friends, states "for of slaves, one perhaps is worth 2 minae ($31.50), another not even half a mina, another 5 minae, another 10. Nicias, the son of Niceratus, is said to have bought an overseer for his silver mines (at Laurium, Greece) at the price of a whole talent" (equivalent to $945 at the time, but, of course, of many times that purchasing power). Even at that time, the services of members of our profession appear to have been appreciated! Strabo mentions the valuable public services of "Crates, the miner, a man of Chalcis," who by clearing out the outlets of lake Capais, in Boeotia, Greece, protected the cities on its banks from floods.

Mining populations nowadays are relatively law abiding, but in ancient times such was not the case. In reference to the gold mines near the ancient Caballa, in Armenia, Strabo states "Alexander (the Great) sent Menon to the mines with a body of soldiers, but he was strangled by the inhabitants of the country" (Vol. II, p. 271).

The financing of mines had already begun, for we read (Vol. II, p. 46) "certain persons, assisted by the wealth of the Romans, lately opened up a large quarry at Taygetum (Sparta)" (Vol. II, p. 46).

Due to the incomplete adjustment of the world's commerce at that time and to the native ignorance of certain of the nomads of the region of the Arabian Gulf, the latter exchanged "gold for three times the quantity of brass and double the quantity of iron" (Vol. III, p. 206). Before the Christian era, the accumulated stocks of metals were relatively small, and rich strikes upset the metal market. The country of the Taurisci (Austria) was at one time tremendously rich in placer gold. Like their fellow countrymen who emigrated to Spain to work the mines there, certain Italians aided the barbarians in exploiting these placers, with the result that "In the space of two months, the value of gold was diminished throughout the whole of Italy by one-third. The Taurisci on discovering this drove out their fellow laborers and only sold the gold themselves." In Strabo's time the mines were in the possession of the Romans (Vol. I, p. 310).

Some of the mines of Pontus were operated by the state, and it will be remembered that those of Laurium were once owned and worked by the city of Athens.

[1]References are to the three-volume edition (1916) of Bohns Classical Library, the translators being H. C. Hamilton and W. Falconer.

Strabo states that in Polybius' time (204-122 B.C.) the silver mines of Cartagena, Spain, "occupy a circuit of 400 stadia, that there are 40,000 men regularly engaged in them, and that they yield daily to the Roman people 25,000 drachme". By the time of Strabo, however, these silver mines had passed into private hands although most of the Spanish gold mines belonged to the state. Mining royalties were not unknown even in that day, for some of the kings of India claimed as their due part of the gold reclaimed from the rivers, as did certain Armenian chieftains (Part III, p. 108).

Keen Rivalry for Supplies

The importance of cheap transport was then recognized, for near the modern town, Frascati, Italy, were stone quarries "affording several different types of rock. As both the carriage from the quarries and the conveyance by river are easy, most of the Roman edifices are built of materials from hence" (Vol. I, p. 354). Much-sought-after metals, however, were already the subject of long sea voyages. Tin and lead were obtained from the Cassiterides (the Scilly Islands, off the Cornish coast) in exchange for earthernware, salt, and brass vessels. "Formerly the Phoenicians alone carried on this traffic from Gades (Cadiz), concealing the passage from everyone, and when the Romans followed a certain ship-master that they also might find the market, the ship-master of jealousy purposely ran his vessel upon a shoal, leading on those who followed him into the same destructive disaster; he himself escaped by means of a fragment of the ship and received from the state the value of the cargo he lost." Eventually, however, a Roman, apparently Publius Crassus, discovered the passage, and finding that the metals were dug at shallow depth and that the Britons were peaceful, he disclosed the route to the Roman mercantile marine.

In Strabo's time, gold was recovered by alluvial mining and in addition by underground mining. The size and depth of the underground workings seem to have been considerable. The Turdetani, a tribe which lived in richly mineralized southwestern Spain, "cut tortuous and deep tunnels, and drained the streams which they frequently encounter by means of Egyptian (Archimides) screws" (Vol. I, p. 221). Unlike the lead-silver mines of Laurium, which apear then to have been yielding little profit, the mines were highly profitable, as the copper ore was one-fourth metal and the silver ore mined was rich. Mining was carried on in a most unsanitary way, as is indicated by Strabo's description of the Sandaraca works, Pontus (modern Tasch-Kopri), where the mountain is "hollowed out by large trenches made by workmen in the process of mining. The work is always carried on at the public charge and slaves were employed in the mine, who had been sold on account of their crimes. Besides the great labor of the employment, the air is said to be destructive of life, and scarcely endurable in consequence of the strong odor issuing from the masses of mineral; hence the slaves are short-lived. The mining is frequently suspended from its becoming unprofitable, for great expense is incurred by the employment of more than 200 workmen, whose number is continually diminishing by disease and fatal accidents" (Vol. II, p. 313).

Placer mines existed in regions in which the gold has by now largely been exhausted; for instance, in the southwest part of Spain, the gold obtained from placers exceeded that procured from mines. Some of the alluvial mining appears to have been merely sluicing of the surficial gravels, but in other cases pits were sunk to the pay streak. Strabo says, "In the beds of the rivers, the sand is either collected and washed in boats close by, or else a pit is dug to which the earth is carried and there washed" (Vol. I, p. 219). Nuggets up to one-half pound weight were in instances found. At some mines, long ditches were constructed to conduct the water to the works. The ancient inhabitants of the province of Galicia, Spain, the Artabri, washed their auriferous gravels "in sieves woven after the fashion of baskets." In the Caucasus Mountains "The winter torrents are said to bring down even gold, which the Barbarians collect in troughs pierced with holes, and lined with fleeces; and hence the fable of the Golden Fleece."

Difficulties over the distribution of water had already arisen. In the country around about Aosta, northwestern Italy, the numerous ditches of the Salassi, in their search for gold, drained the bed of the Doria Baltea dry. The agriculturists living downstream, whose crops depended upon the river for water, frequently in consequence warred with the Salassi. The latter, even after the Romans took over the country and the gold mines, held the headwaters and sold water to "the public contractors of the gold mines." The avarice of the latter caused continual disputes, which eventually served as pretexts for the Roman generals to send punitive expeditions against the mountaineers (Vol. I, p. 305).

Items of interest to the metallurgists are also found. The refining of gold bullion is described in detail (Vol. II, p. 220). The treeless aspect of the country around some mines and smelters is nothing new, for Strabo quotes Eratosthenes as saying that the dense forests of Cyprus once prevented farming, but that "the trees were cut down to smelt the copper and silver" (Vol. III, p. 71). At the Laurium mines, partially worked out even in Strabo's time, "The workmen when the mines yielded a bad return to their labour, committed to the furnace the old refuse and scoria, and hence obtained very pure silver, for the former workmen had carried on the process in the furnace unskillfully" (Vol. II. p. 91). The lead ore of Castlon (now Caslona), Spain, contained silver, but in too small quantity to pay for separation (Vol. I, p. 222). He also describes in detail the methods by which the silver ores from the vicinity of Cartagena, Spain, were crushed and washed by hand five times before being smelted (Vol. I, p. 222).

The countries known to Strabo produced in 1913 approximately 7 per cent of the gold production of the world; 10 per cent of the silver; 12 per cent of the copper; 46 per cent of the lead, and 6 per cent of the tin.

Spain a Leading Precious Metal Producer Then

The most important gold producing country was Spain, particularly the Huelva district, and, after it, India and the Red Sea coast of Egypt, but it was also obtained from Britain, France, Switzerland, Italy, Austria, Greece, Asia Minor, the Caucasus and Ural Mountains, and from Kerman (Asia Minor near Persia).

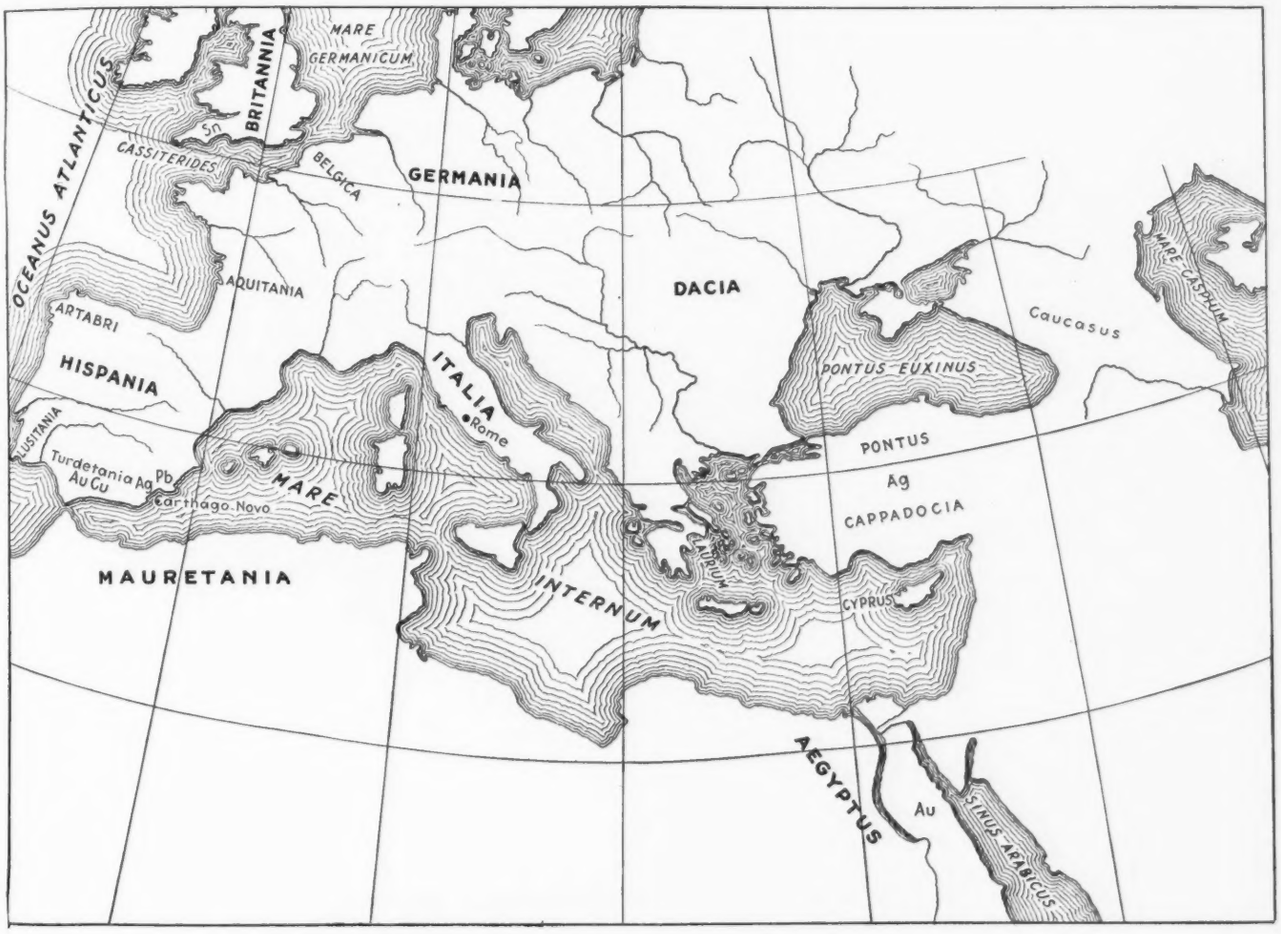
At the time Spain appears to have been the principal producer of silver, the production coming both from the extensively developed lode mines in the vicinity of Cartagena and Alcolea and from the silver content or placer gold. It was also obtained in the Caucasus, Asia Minor, Great Britain, Greece, Dalmatia, Macedonia, Cyprus (as a byproduct of copper mining), India, Persia, and Arabia.

Spain, especially the Huelva district, and Cyprus were the chief sources of copper. The ore from Spain is reported to have contained 25 per cent copper. Other less important producers were Italy, Eubœa, Asia Minor, Persia, Egypt, and Morocco. Lead was obtained from Spain and Great Britain. Tin was obtained from Great Britain, Spain, and Sigiston (near Persia). In Spain, at least, shallow lode mines as well as stream gravels were worked.

Strabo himself appears to have been somewhat of an oil sceptic. After stating that a spring of oil was discovered near the Ochus River (near Oxus, Persia) in digging a hole, he adds, "It is probable that as certain nitrous, astringent, bituminous, and sulphurous fluids permeate the earth, greasy fluids may be found, but the rarity of their occurrence makes their existence almost doubtful." In Arabia, when the traders who accompanied the caravans of perfumes and spices became drowsy from the odor of their goods, they overcame it by "the fumes of asphaltus." Soil containing asphalt from both Asia Minor and the Island of Rhodes was used as an insecticide in viticulture.

Only the more interesting references to non-metallic minerals will be noted. In the Island of Eubœa, off the Grecian coast, asbestos was obtained and woven into napkins which were cleaned by being "thrown into the fire." At Pozzuoli, Italy, the sand "contains much gypsum and will cement and consolidate thoroughly" under water (Vol. I, p. 365), an early reference to the well-known natural hydraulic cement. The Chaldean town of Gerrha, in Arabia, had its houses constructed of salt, and "as scales of salt separated by the burning of the sun are continually falling off, the houses are sprinkled with water and the walls are thus kept firm together."

Among the precious and semi-precious stones mentioned are amber, crystal, onyx, emerald, garnet, and olivine. The love of the Hindoos, the Persians, and the Arabians for a lavish display of precious stones was already highly developed. Eudoxus, an Egyptian merchant, who visited India about 170 B.C., is quoted as saying of precious stones "some . . . the Indians collect (Vol. I, p. 149) from amongst the pebbles of the river, others they dig out of the earth where they have been formed by the moisture, as crystals are formed with us."



Map showing the known parts of Europe in the time of Christ

Gold and Sulphur Produced in Ecuador

The only mineral production in Ecuador of importance is that of gold, from the mines of the South American Development Co. at Porto Velo, operated under contract with the Ecuadorian Government, according to *Commerce Reports*. Pratically the entire output of these mines is exported to the United States in the form of gold precipitates, which, during 1922, amounted to 20,205 lb., valued at $877,646.

A limited amount of sulphur for local consumption is mined near Guayaquil. It is reported that these sulphur deposits are large and capable of further development without the investment of a large amount of capital.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Prospecting Stifled by Forestalling

THE EDITOR:

Sir—The letter in the *Journal-Press* of Dec. 29 entitled "What has Become of the Prospector" is a welcome variation from the twaddle usually published on the subject. It is surprising that a mere "prospector and miner" should be able to so clearly expose the facts when so many engineers have contented themselves with camouflaging them. Perhaps the latter have written on prospecting as yellow journalists write of battles, relying on their imagination in the office rather than on their observations in the field. The subject of the forestalling of mining ground, which seems taboo to most of our office "engineers," is one that "Prospector" handles without gloves. Until this skeleton of the mineral industry is dragged out of the closet and exposed in all its absurdity to public derision, it is safe to say that the decline in prospecting can never be halted.

The existing American laws governing mineral-land titles are a hodgepodge of several ancient systems. We have first the Spanish system, as existing in the Code of Carlos III, of 1783, which assumes the mineral deposit to be a separate property from the surface and inalienable property of the nation. Individuals are allowed to work mines, but only under leases which prescribe as obligations for a quiet title the payment of royalty and continuous work. Next we have the English medieval system, which gave the minerals to the landlord instead of the King; but in those days the landlord was the local governor and had to expend most of his revenue from his lord's dues in supplying the public service. Lastly we have the Roman or alloidal tenure in which the landlord owns the minerals as well as the surface, but as here he has no obligatory public functions like the feudal landowner he retains his mineral rents for himself, except such portion as he is required by the state to contribute as taxes.

In our eastern states the mining laws follow the Roman system, whereas the federal law of the West is a combination of this with the Spanish idea derived from Mexico. Under the latter laws mineral-claim property includes both surface and underground rights, after the Roman idea, but its tenure follows the Spanish system, as the title reverts to the nation in case of failure to perform the annual assessment work. Later, when the "claim" leaser has taken advantage of the federal law and acquired a title by "patent," his property becomes entirely a tenure under the Roman system, both in kind and obligations.

The experience of "Prospector" shows that both the "claim" and "patent" tenures of the present federal law are favorable to forestallers and disastrous to prospectors. The legal obligations for holding a claim are not enforced in practice, and the method of controlling patent ground by taxation is either unknown or disregarded by local officials. Yet all these troubles regarding mineral-land tenures can easily be cured whenever we get ready to harmonize them with the principles of our democratic political system. As long as we retain the English tenure of feudalism or the Roman tenure of plutocratic imperialism, we should expect no relief, but rather an aggravation of land-forestalling and monopoly as the population becomes denser.

Theory indicates and the experience of the last 140 years has demonstrated that the Spanish tenure is the only just and democratic one. Our present hodgepodge of systems, moreover, could be easily altered into the Spanish tenure by declaring all underground rights a separate property from the overlying surface and treating each separately as regards taxation and development. But it takes no prophet to predict that such an alteration will never take place until scientific engineers, in self-defence, enter politics and break up the present control of our legislation by archaic lawyers.

Ixmiquilpan, Mexico. ROBERT BRUCE BRINSMADE.

Domestic Manganese Mining

THE EDITOR:

Sir—The review by Charles Hardy on "Manganese in 1923," in the Review Number and Year Book just received, and his speculations as to the difference of 100,000 tons consumed over and above that imported, led me into a search through the Year Book for United States manganese productions. Though quantities as small as the one ton imported from China mentioned by Mr. Hardy, and 4,000 tons of chemical ore produced in Cuba, are mentioned, nothing is said regarding domestic production. The Hi-grade Manganese Co., for instance, operated two mines in Shenandoah County, Va., throughout the year. And it also erected and placed in operation a well-equipped crushing plant at Strasburg, Va. I understand manganese is being mined in Arkansas and some of the western states as well.

In view of the present tariff on manganese ore it would be rather interesting to learn what portion of the 33⅓ per cent consumption unaccounted for might be credited to our own mines. J. C. METGER.

Parnassus, Pa.

Origin of Petroleum

THE EDITOR:

Sir—In the *Journal-Press* of Jan. 19 you make the statement in an article on "Ore Magmas" that petroleum belongs to a group of mineral deposits which, like coal and most iron ores and salt, have been formed in what you call the "atmosphere-rock contact zone." This can only mean that you think petroleum is of organic origin, as whenever the atmosphere enters into the development or growth of any substance, either animal or vegetable, then oxygen enters into its composition.

Except for the accidental presence of water in the form of an emulsion, petroleum has no oxygen in its composition. If sufficient care is taken it can be entirely deprived of all contained waters and, consequently of oxygen.

For the purpose of disproving the popular belief that petroleum is of organic origin it is only necessary to call attention to the table of analyses below and keep in mind that petroleum has no oxygen in its composition, while all organic substances, whether animal or vegetable, have, and, further, that this oxygen is combined with carbon and hydrogen. The only elements which have a stronger affinity for oxygen than carbon and hydrogen are not able to exist in a free state in nature in the presence of water because they decompose water in order to get the oxygen which is in combination with hydrogen. These elements are sodium, potassium, magnesium and some others of the same chemical group which have been separated in the laboratory. In order to produce petroleum, which has no oxygen in its composition, out of organic matter, which has according to these analyses up to 42 per cent in the case of wood cellulose, it will be necessary to combine the oxygen with some element with which it has a stronger affinity than it has for either carbon or hydrogen. Like the man who saw for the first time a picture of a giraffe, I would say "there ain't no such animal."

	C	H	O
	Per Cent		
Wood cellulose	52.65	5.25	42.1
Peat	62.44	5.96	33.6
Lignite	66.96	5.27	27.77
Brown coal	74	5.89	19.91
Bituminous coal	76.18	5.64	18.08
Semi-anthracite	90.5	5.05	4.04
Anthracite	92.85	3.96	3.19

The above analyses are taken from the book "Coal in Australia" by Danous Powers.

	C	H	O
Tar artiifical	86.56	7.06	4.4
Alcohol C_2H_5OH	.....	....	34.78

These last two analyses are from the *American Chemical Journal* and are added to show that distillation does not eliminate the oxygen from its products.

As can be seen from their chemical formulas, sugar, alcohol, turpentine or any vegetable or animal oil all contain from 30 to 40 per cent of oxygen and this oxygen is in combination with carbon and hydrogen and cannot be disassociated from them except by combining it with something for which it has a stronger affinity than for either or both of them. Such elements are known but they cannot exist in the presence of water in a free state because they decompose water to get its oxygen. As there is always water present in the atmosphere and always has been, it is idle to say that petroleum could have been produced by the action of any such elements on organic matter.

It has been suggested that bacteria have been the means of reducing organic matter so that it could be converted into petroleum, but bacteria are themselves organic and therefore contain a large percentage of oxygen and it is characteristic of all organisms that their excreta or byproducts contain much the same elements as they themselves contain, so that bacteria, unless they can be shown to be a reducing agent, are demobilised as petroleum producers.

It is therefore shown that, according to our best knowledge of chemistry, petroleum cannot be of organic origin, and the only alternative is that it is of inorganic origin and essentially a magmatic differentiation product. This receives support from the known occurrences of graphite associated with mineral veins and also with granite, the graphite being a decomposition product of hydrocarbons which came up with the magmatic waters and from the same source.

Montreux, Switzerland. HIRAM W. HIXON.

Concerning Rich Ore in the Marmajito

THE EDITOR:

Sir—I was extremely interested to read Mr. Cragoe's letter under "Concerning Rich Ore," which appeared in your issue of Dec. 1, 1923. In this letter he mentions the Marmajito mine, in reference to which he says that the main lode assayed month in, month out, about 30 oz. coarse free gold per ton over about 3½ ft. I have heard the old miners say that some very rich ore was taken out near the surface, and a few cars or barrows to the old mill of sorted ore may have given the assay value stated, but I do not think that Mr. Cragoe saw 30-oz. stuff coming from adit or below, nor did he see many sections of vein 3½ ft. in width, giving anything like this value month in, month out.

One of the characteristics of Marmajito is that the wider the vein the poorer the values and vice versa. Nowadays when the vein assumes a width of about 3 ft., the values are in the neighborhood of 10 and even less dwt. per ton. On the other hand I have taken a sample from a 6-in. vein section which has assayed 23 oz. per ton. The average width of the vein, however, throughout the mine, that is, over a length of about 450 meters, and a 30-deg. inclined depth of 110 meters below adit, is 12 in. assaying 20 dwt. per ton. This is the stuff that is going to the mill month in, month out, twenty-seven years later.

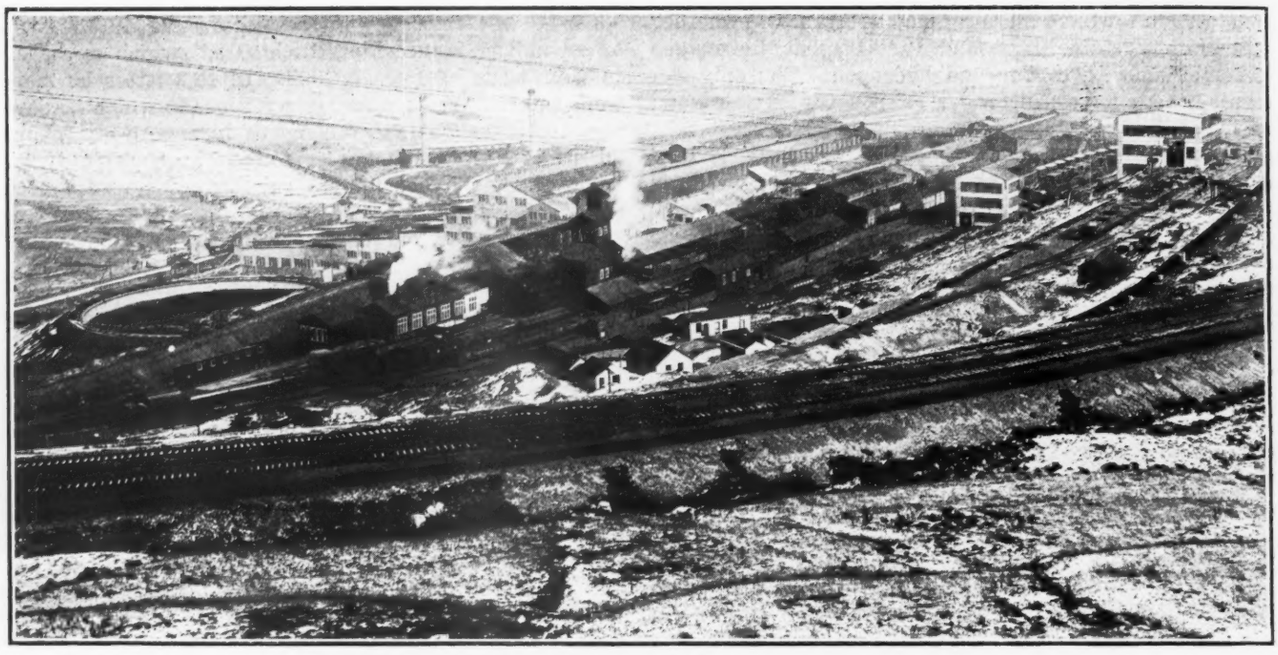
Mr. Cragoe also states that only 33 per cent extraction was made in the mill and 20 oz. tailings ran down the stream. This seems a very low extraction even in the crudest of native mills, as the Marmajito ore is very adaptable to amalgamation. In the present Californian mill, about 80 per cent of the gross value is recovered by amalgamation, and 70 per cent of this in the boxes. The concentrates, representing about 0.6 per cent of the tonnage, consisting of pyrites, galena and a little blende, when exceedingly clean, assay about 90 dwt. per ton, the sand tails about 5 dwt., and the slimes about 3 dwt. per ton. Further, the present company has treated several hundred tons of old mill tailings, the average value being about 4½ dwt. per ton. These sands, although accumulated from milling operations later than the time of Mr. Cragoe, nevertheless resulted from crude milling methods—and show the great care taken to obtain as good an extraction as possible.

Further I do not agree with Mr. Cragoe in his statement that he would back any good mine captain of Cornish origin, or any experienced Mexican or South American foreman against the most highly trained engineer to find ore and stay with it when found. He apparently overlooks the history of the Keeley Silver Mines, which he mentions, where the miner had worked out what he thought was the last of the ore, and a whole district was practically abandoned thereby. It required the highly trained experience and knowledge of an engineer and geologist, Dr. J. Mackintosh Bell, to advise the present development which has led to the rich discoveries at the Keeley. Similarly at Marmajito it was easy for the Cornish miner to work out the rich surface orebodies, but it requires the engineer to guide the company to work successfully what he left.

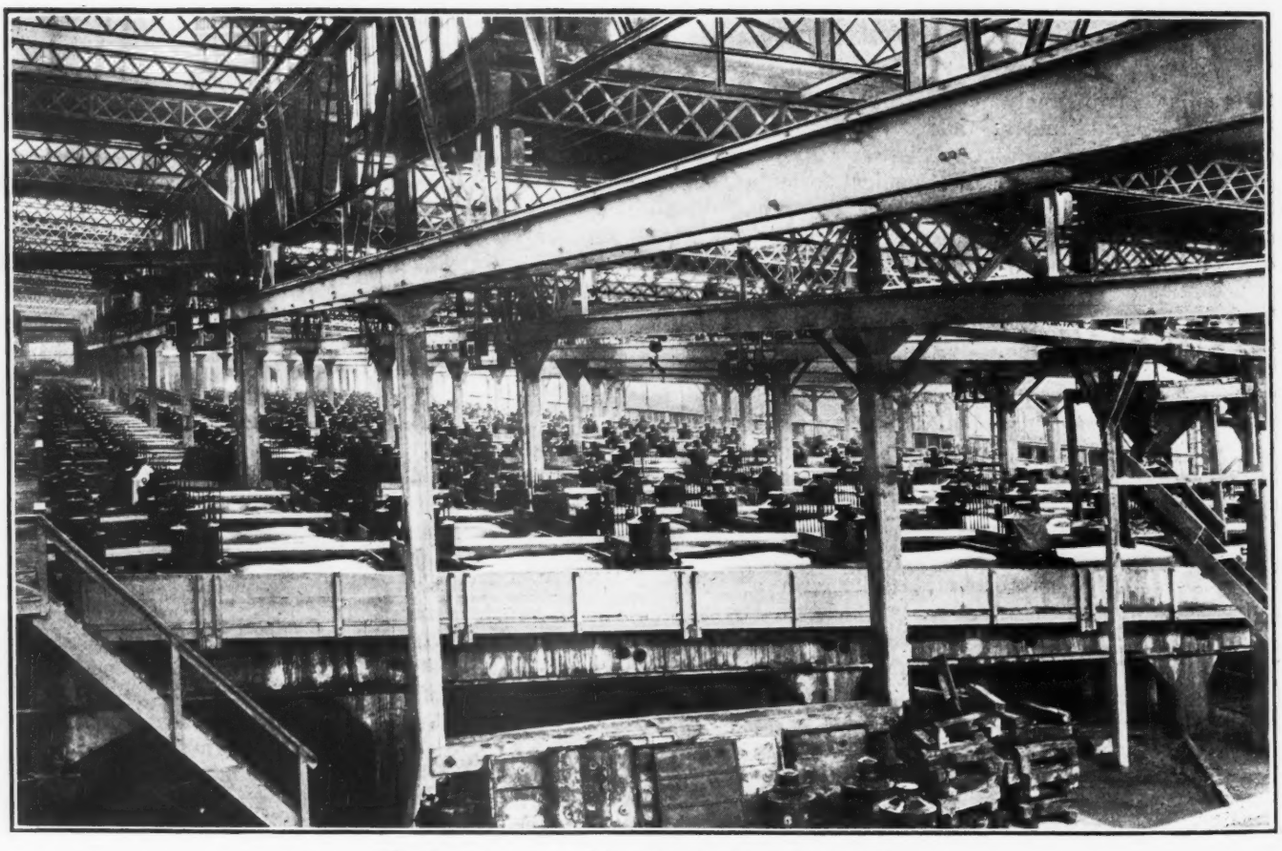
Marmajito Mines, Colombia. R. ALLISON PURVIS.

Views of the World's Biggest Concentration Plant

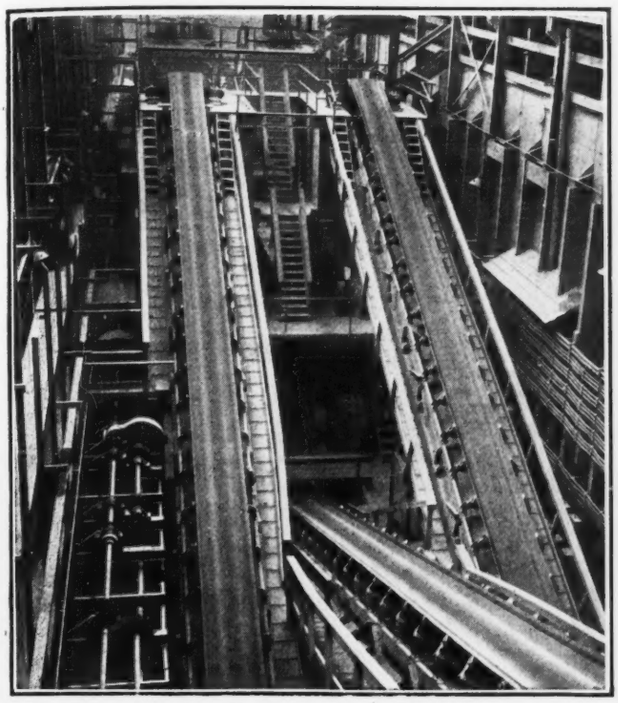
The Magna plant of the Utah Copper Co. at Garfield, Utah, crushes and treats 24,000 tons of ore per day. These photographs were obtained through the courtesy of L. S. Cates, general manager for the company



General view of the plant looking northeasterly

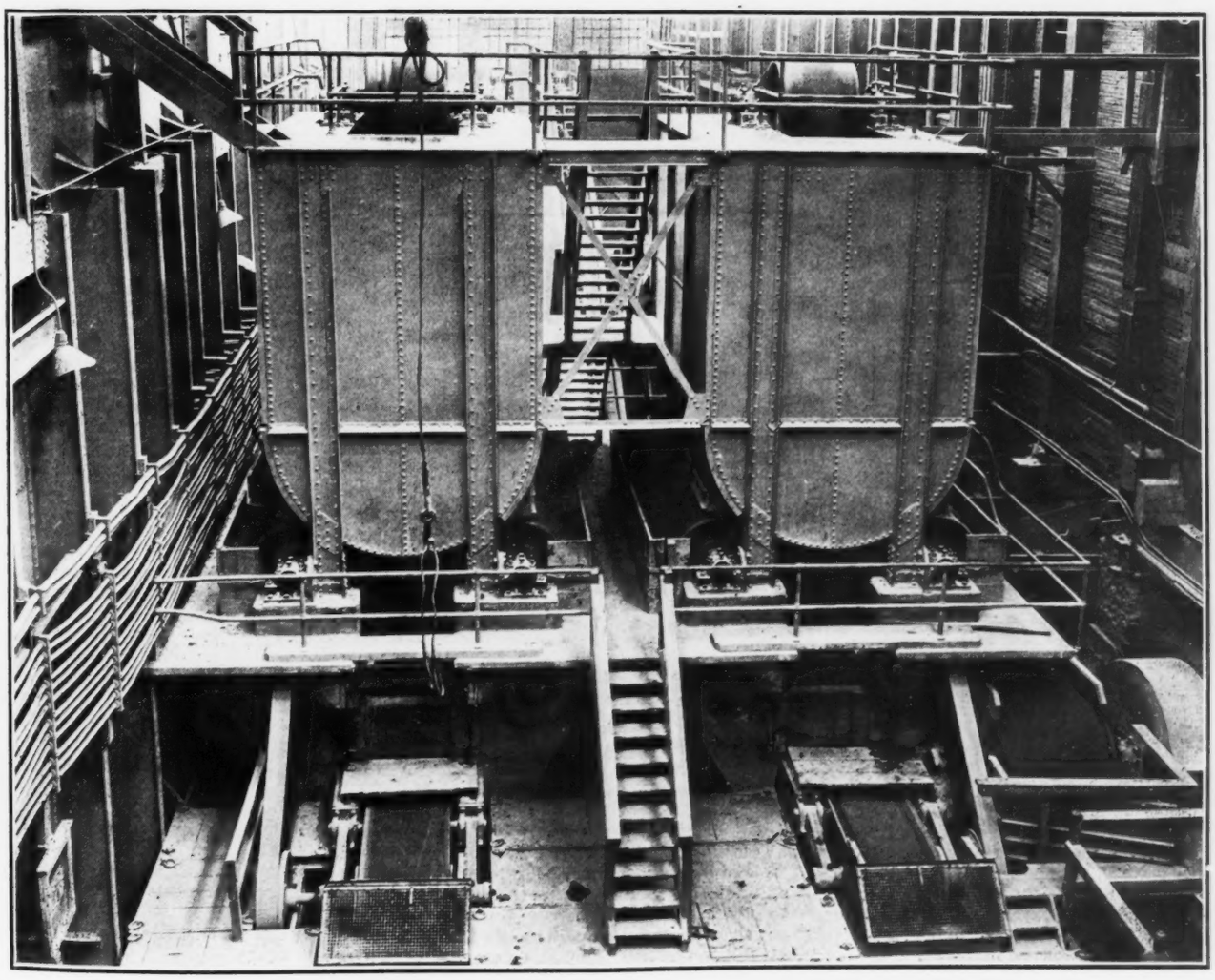


Regiments of machines in the flotation section



Conveyors feeding rolls in secondary crushing department

Ball mills in the regrinding department



Receiving towers for rotary feeders in secondary crushing plant

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

IRON mining companies in Michigan are engaged in re-building their stock piles, most of which were depleted by the heavy shipments of the 1923 season. An equally large tonnage is expected to move during 1924.

Purchases of new equipment by the Chino Copper Co. during 1923 exceeded $1,200,000.

A mill and flotation plant will be built by the Treadwell Yukon Co., Ltd. at its property at Mayo, Y. T.

Calumet & Hecla Consolidated has passed its current dividend in preference to depleting its capital reserve.

Good ore has been found in the deeper levels of the mines in the Republic district in Washington.

Increased ore reserves and decreased current output and profit are shown in the Hollinger annual report.

Proposed legislation, if passed, will equalize mine taxes in Ontario, to the benefit of the nickel producers.

After a thorough overhauling the Nabob mill, in the Coeur d'Alene district of Idaho, is ready to start.

A single blast containing 301,200 lb. of special powder, recently fired in Utah, is believed to be the biggest on record.

An action for foreclosure will doubtless result in the acquisition of control of the Utah Consolidated by Anaconda, through the International Smelting Co. Utah Con. is indebted to Anaconda for the amount of the loan that settled the damage claim of the Utah-Apex company.

Operators in the Tri-State zinc field will co-operate with the Senate Gold-Silver Commission in determining average production costs.

Early Spring Promises Activity At Pioche, Nev.

Combined Metals to Ship—Prospects at Comet Optioned—Mill for Mendha Mine

The Combined Metals Co. will commence shipping from its property at Pioche, Nev., during March; the ore will be stockpiled at Bauer to await the completion of work at the milling plant now being rushed to early completion. Fifteen men are now employed at the mine putting same in shape for production. A. H. Williams is superintendent and E. H. Snyder is manager.

The Raymond & Ely Extension Mining Co. will commence operations in Pioche in the month of March. Two carloads of shaft timber are now on the road to Pioche and will be utilized in the retimbering of the old Meadow Valley No. 9 shaft which will be sunk to a depth of 1,000 ft. The rich fissure veins, so productive in the early seventies, extend through the property. The management of the company is virtually the same as that of the Combined Metals Co.

Two properties have recently been optioned in the Comet district near Pioche. The Lyndon mine owned by Charles Schodde is under investigation by Los Angeles interests. A recent strike by the owner in a winze sunk from the tunnel has attracted renewed attention to the district; 6 ft. of heavy silver-lead ore, assaying 72 oz. silver and 40 per cent in lead, is exposed in a raise run from the 50-ft. level of the winze and ore is being sacked for shipment.

New York interests have taken an option on the Non Pareil mine owned by local mining men, this property adjoins the Lyndon and has a number of ore showings meriting development.

Development of the Ellis property at Fairview continues to open up lead ore of milling grade. The work is being financed by Seattle people. J. W. Robinson of Pioche is superintendent.

At the Mendha mine, the mining firm of Squires & Gemmill is erecting a mill to treat the ore, a large tonnage of which has been developed underground. Milling operations should commence in March with a continuance of the present open weather.

U. S. Company Builds New Change-House at Bingham

The change-house which is being built by the United States Mining Co. at its Bingham property, at a cost of $45,000, is being rapidly completed. A stairway from the main tunnel of the mine leads directly into the building, so that employees may enter immediately from work, without being exposed to the weather in wet clothing.

What if This Shot Had Missed Fire!

Explosion Uses 301,200 Lb. of Special Powder—Biggest Industrial Blast on Record

The Southern Pacific Railroad Co. on Feb. 16, near the shores of Great Salt Lake, 46 miles from Ogden, Utah, fired what is believed to be the greatest blast ever set off in the history of industry. This blast, which was undertaken to provide material to raise the fills that are approaches to the Great Salt Lake trestle—the Lucin Cut-off—raised an estimated volume of 550,000 cu.yd. of rock and earth, and consumed 301,200 lb. of special-process powder (equivalent to 600,000 lb. of black powder). The placing of the explosives in tunnels, aggregating 4,100 ft. in length, occupied twenty-five men forty-five days. A mountain 275 ft. high and covering a face of approximately 1,000 ft. in length was lifted up and separated into fragments, and spread over an area of 360,000 sq.ft. Railroad officials, engineers, and others from Salt Lake, Ogden, San Francisco, and other Pacific points, were present to witness the explosion, as well as motion picture camera men. Arrangements for the blast were made by Otis Weeks, division engineer; C. E. Fish, assistant engineer of the Southern Pacific; and Hyrum Peterson, explosives engineer for the Hercules Powder Co.

Decreased Output and Increased Reserves Feature Hollinger Report

Power Shortage Assigned as Cause for Difficulty—Surplus Drawn on for Dividend—Much New Plant

The annual report of the Hollinger Consolidated Gold Mines of Ontario for 1923 does not show anything unexpected. Production amounted to $10,446,000, a decrease of $1,830,000, and profits, after depreciation and taxes, were $2,952,000, a decrease of $2,190,000. The average daily tonnage treated was 3,764, a decrease of 333 tons, and the production and profits, together with increased costs, are due to the power shortage in the early months of the year. The lower grade is also attributed to the same cause, a much larger proportion than usual of the tons milled coming from development. The cost totalled $4.86 a ton, as compared with $4.26 in 1922.

Total assets are placed at $30,984,000, current assets being $6,589,000 and surplus $9,832,000. Dividends paid during the year amounted to $3,198,000, which necessitated drawing upon the surplus to the extent of $246,000. While profits during the latter months of the year were considerably in excess of dividend requirements, it is considered advisable to defer any dividend increase until the company's power development is completed and the power situation stabilized, so that an addition to the dividend, once made, may be reasonably permanent. It is pointed out that during the comparatively short life of the company it has disbursed in dividends a larger proportion of its profits than any other large gold mining company operating in the world.

During the year expenditures on capital account amounted to $2,067,000 and included the balance of the purchase price of the Schumacher mine, $888,750, plant additions $793,600, hydro-electric power development $306,155 and tailings disposal site $84,000. It is proposed to borrow $3,500,000 at 6 per cent, secured by certain of the company's securities, to complete the power plant, and at the annual meeting shareholders will be asked to ratify a by-law authorizing this financing.

The most signficant feature of the report is the estimate of ore reserves which is placed at 6,338,000 tons, averaging $8.97 a ton, an aggregate of $56,862,000, as compared with 4,600,000 tons averaging $9.39, an aggregate of $43,270,000 in 1922. Total development and exploration footage during the year was 59,700 ft.

Mill for Chloride Queen

The Chloride Queen mine, operating fourteen miles north of Colville, Wash., will soon start the erection of a concentrator. The mine has been undergoing development work for two years. Recently a new orebody has been cut. A carload of sorted ore from the new strike has just left the mine, but the mill will be pushed rapidly to completion so that concentrates can be shipped. The ore is galena carrying some silver.

New Company Opens Asbestos Mine at Kamiah, Ida.

The Panhandle Asbestos Mining Co. of Lewiston, Ida. has acquired asbestos mines near Kamiah, Ida. and will erect a plant for the manufacture of asbestos chimney bricks and shingles at Lewiston. According to a report of L. O. Howard, professor of mining engineering at the Washington State College, there are many uses for the material of the kind and grade developed at the Kamiah mine. It is estimated that the material can be mined and placed on cars at Kamiah for shipment for from $5 to $10 per ton and that it will well be worth $20 to $25 per ton.

Calumet & Hecla Consolidated Passes Quarterly Dividend

Directors of the Calumet & Hecla Consolidated Mining Co. have passed the usual quarterly dividend of 50c. due to be declared at this time. The company paid a dividend of 50c. a share in December. With output of 7,000,000 lb. a month, the dividend of 50c. required a profit of 4½c. a pound. With copper selling between 12⅞ and 13½c. a pound during recent months it was obvious that the consolidated company could not earn its dividend, and it became a question whether the company would deplete its cash position or discontinue dividend payments.

Anaconda Will Spend $400,000 Deepening Six Shafts at Butte to 3,500 Ft.

The Anaconda Copper Mining Co. has announced a development program of great proportions for its mines at Butte, Mont. At six of the largest mines, shaft sinking will be underway within a month. In all about 4,000 ft. of shaft will be sunk. This work will mean an expenditure of about $400,000. The mines involved and the work planned are shown in the following table, the figures being in feet.

Mine	Present Depth	Proposed Depth	New Work
Mountain Con.	2,900	3,500	600
Badger State	2,800	3,500	700
Belmont	3,000	3,500	500
Mountain View	2,000	3,400	1,400
Rarus	2,800	3,500	700
Pennsylvania	2,900	3,500	600

In some ways this is the largest program of shaft sinking ever planned, and yet it is only a beginning of a systematic development of the network of orebodies in Anaconda Hill. For years the geological department of the Anaconda company has been engaged in a careful analysis of the geological structure and the present work is designed to enable the mining of vast orebodies the existence of which is known. The running of the necessary crosscuts and drifts from the lower levels as they are opened, will require thousands of feet of work.

Comparatively little shaft sinking has been done by the Anaconda company during the past ten years. The present project will necessitate the purchase of a large amount of new equipment much of which is now being installed. A large item in the material bill will be the timber. The character of the ground at Butte is such that heavy and close timbering is necessary and large quantities of Oregon fir will be used.

Trail Board of Trade Asks Tax Exemption for Mining

The Board of Trade, at Trail, B. C., unanimously passed the three following resolutions at a meeting held on Feb. 15.

"That the Provincial Government be requested to exempt from all income taxes all profits re-invested during the year for the construction of new plant or the enlarging of existing plant for ore-reduction in British Columbia.

"That the Provincial Government be recommended to remove the obstacle to the importation of capital by amending the Taxation act in such a manner that deduction of interest on capital, whenever it is borrowed, be remitted in assessing income tax.

"That the Lieutenant-Governor in Council be recommended to fix the income tax on mining operations at not over one-half the rate imposed upon other industries."

S. G. Blaylock, managing director of the Consolidated Mining & Smelting Co., introduced the first resolution. All resolutions were preceded by lengthy preambles.

Hecla Nears Normal Output in the Coeur d'Alene

The Hecla Mining Co. operating in the Coeur d'Alene district, in Idaho, is now producing on a basis of between 80 and 90 per cent of normal, and it is expected that by the last of March, possible earlier, it will be turning out the maximum and the mill running at its usual capacity of 700 tons per day. James F. McCarthy, president and general manager of Hecla, attended the meeting of the directors of the company at Milwaukee on Feb. 13, when a dividend of 25c. per share was declared, payable March 15. In spite of its heavy loss by fire last year and heavier expense of rebuilding, Hecla never passed a dividend, paying a total in 1923 of $1,150,000. The current dividend will bring the total paid by the company up to $11,355,000. Hecla was protected by fire insurance to the extent of $337,000, and also a "use and occupancy" policy for $1,000,000, under which it is estimated that the company will receive or has received something over $600,000, although on this point there is no official information at this time.

Nickel Mines Would Gain from Proposed Legislation

Bill Equalizes Ontario Taxes on All Mines—Bounty for Iron Mining Would Stimulate Exploitation

Two measures have recently been introduced in the Ontario Legislature which are important to the mining industry of the Province. One bill is to equalize mine taxation so that the nickel mines will not have to pay a greater profits tax than any other branch of the industry. The general rate of taxation is 3 per cent on the net profits above $10,000 and up to $1,000,000 and 5 per cent on profits above $1,000,000. The municipalities obtain one-half of this tax and have no power to assess any tax on profits or royalty on production. During the war the nickel industry was much in the limelight, the International Nickel Co. particularly coming in for a great deal of attention from both the Dominion and Provincial Governments. This, company had, by special arrangement with the Government, paid a lump sum per year, which was very much less than would have been realized by the 3 per cent tax. A nickel commission was appointed to study the whole question, including taxes, and acting on the commission's report the tax rate was changed to make it 5 per cent of the first $1,000,000 profits and 7 per cent above $1,000,000. The present government feels that this discrimination is unfair and is putting all mines on the same basis. The Ontario mining tax is an eminently fair and reasonable one, and one with which the industry has no complaint.

The other bill being introduced in the house deals with the question of paying a bounty on iron ores. The province has an important iron and steel industry, but all iron ores used in the furnaces are imported. There are known deposits in Ontario containing approximately 500,000,000 tons of iron ore, which needs to be beneficiated before it is marketable. The treatment of these ores appears to have been solved, but in order to encourage the entrance of capital and to enable the companies to get a start until they are self sustaining it is considered necessary to pay a bounty. The bill provides for a bounty of ½c. per unit of iron in beneficiated ore which is sold, and is conditional upon the payment of a like amount by the Dominion Government.

Scow Seaworthy, Premier Must Stand Loss of Ore

In the Supreme Court of British Columbia Justice Gregory rendered a decision against the Premier Gold Mining Co. of British Columbia in its action for the recovery of $17,600 from the Coastwise Steamship & Barge Co., the sum being the value of a scowload of ore lost in transit from Stewart to Anyox. Justice Gregory found that the defendants had proved that the scow was seaworthy, but was caught in an unusually severe storm and the load was lost by the perils of sea. The scow was towed to Anyox, bottom upward, and has been used since.

Can This Be the Next Big Goldfield?

A new gold strike has been reported at Goldbasin, about half way between Fallon and Austin, Nev. A 10-ft. outcrop is said to assay $10 per ton in free milling gold, and placer dirt in the vicinity shows values up to $50 per yard. The find is new and consequently very little work has been accomplished so far. Considerable interest is manifested and many prospectors are headed that way to make locations.

George Graham Rice Now Heads Idaho Gold Corporation

George Graham Rice, notorious mine promoter of New York, has been chosen president of the Idaho Gold Corporation, according to Stewart Campbell, Idaho State Mine Inspector, who recently conducted an investigation into the methods used by that company in Idaho and the operation of its holdings at Rocky Bar. The certificate was filed with the secretary of state's office and E. E. Lothrop of Rocky Bar was named as the fiscal agent of the company.

Rice succeeds Samuel Newhouse of Salt Lake, who recently resigned as president of the company when Mr. Campbell issued a statement that the publicity literature of the company was misleading.

The necessary reports of the company to comply with the Idaho legal requirements were also filed at Boise on Feb. 4. A complete new set of officers is named and the report shows that all stock is issued.

Seneca Increases Copper Output to 600,000-Lb. Basis

Seneca copper rock tonnage has reached an average of 850 tons per day, with about an equal amount coming from both shafts, Gratiot No. 2 and Seneca shaft. This amount will be gradually increased as more stopes are opened. With an average of 30 lb. of copper per ton treated, present tonnage puts Seneca on a production basis of better than 600,000 lb. of refined copper per month.

Rapid progress is being made in sinking Gratiot No. 2 shaft and in raising from the Seneca third-level north drift to connect with the shaft. The connection should be complete by April 1. It will ventilate seneca openings and facilitate mining operations, making possible a large tonnage from the third level. Stoping in Gratiot No. 2 shaft is confined to the 13th and 11th levels, which are connected by a raise at the south. Stoping soon will be possible on three additional levels, the 9th, 14th and 15th, which are nearing the Mohawk boundary, and which will be connected by raises. Rock hoisted in the Seneca shaft is from stopes in the 7th or bottom level, both north and south, this ground being particularly well charged with heavy copper.

Treadwell Yukon Plans Mill for Mayo Property, Y. T.

Long Adit Taps Mine on 600 Level—Flotation Will Make Rich Lead-Silver Concentrate

The Treadwell Yukon Co., Ltd., which is operating in the Mayo district, Yukon territory, and is controlled by F. W. Bradley, will erect a mill during the coming year. The company shipped 4,000 tons of ore in 1923 and at the close of 1923 had 3,000 tons of ore ready for shipment. The latter tonnage is being sacked and shipped at the rate of from 400 to 600 tons per month. Shipments to the Bunker Hill smelter at Kellogg, Idaho, will continue as long as transportation permits. Two ten-ton Holt tractors of the northern logger type are in constant use, with a third tractor in reserve. Twenty-four heavy logging sleds are operated in trains of four each for transportation of the ore to the Stewart River.

The company is driving an adit, 2,600 ft. in length at the 600-ft. level of the mine. A raise will be extended to the 300-ft. level, the present lowest level of the mine. Development of intermediate levels will be completed as fast as they are needed for production.

When the adit is completed the milling plant will be constructed. The crushing equipment and ore-storage bins will be underground and the fine crushing and flotation equipment will be housed close to the shaft at the surface. The mill will be equipped with a conical ball mill and M. S. flotation machines and will have a capacity of 50 tons per shift. The ore is a silver-lead ore containing galena, sphalerite and silver minerals in a siderite gangue. Designs are being prepared by Lloyd White of the firm of Burch, Hershey and White of San Francisco.

Activities at Keno Hill are restricted to the operations of the two large companies, the Treadwell Yukon Co., Ltd., and Keno Hill, Ltd., and individual prospectors who ship from 20 to 100 tons of ore during the season. Five or more small producers are active. Their product is sold to the larger companies who buy the ores on the basis of smelter schedules less transportation and other necessary charges. An initial payment is made and final settlement when the shipments have been received at the smelters.

Operating costs in the Mayo district are decreasing but the conditions are such that individual operators must be able to finance a full year's operation. Although many prospects have been discovered development costs are such as to restrict the opening of them except where high-grade ore is available near the surface. Access to the district has improved slightly and more steamers run up the Stewart River.

Add to Nicaraguan Plant

The Bonanza Mines Co. operating in the Pis-Pis district, in Nicaragua, is completing a slime adjunct to its cyanide plant in order to improve the recovery; a modified Eden filter is being built. Benj. C. Warwick, manager of the mine, has returned to Nicaragua to direct operations.

Rebuilding Stock Piles on Marquette Iron Range

Heavy Shipments Looked for Again this Season—H. Ford Busy—Cleveland-Cliffs Completes Dam

With stockpiles generally well cleaned up at the close of lake navigation last fall, the mines of the Marquette iron range, in Michigan, are all actively engaged in creating new ones with the idea that the present year will need a greater ore tonnage than last to meet the requirements of consumers. Last year the twenty-four mines now operating on this range shipped 3,892,666 gross tons, which was considerably in excess of the previous years performance. Being the oldest of the Lake Superior ranges there is comparatively little in the line of new discoveries.

The Ford Motor interests recently came into the possession of the Imperial mine at the western end of the range through the purchase of 400,000 acres of land from the Michigan Land & Iron Co. and produced from this property 211,302 tons of ore last year. They will strive for a greater output this year. This celebrated motor company is operating several diamond drills in this country; two near Republic, and two on lands of the Ohio Mining Co., not far from the Village of Michigamme. One of these drills is located directly in the Spurr River and report has it that important ore deposits have been found.

The Cleveland-Cliffs Iron Co., one of the largest of the so-called independent miners of the Lake Superior region, has reopened its Salisbury mine that had been closed for a year or more. This property is located in the city of Ishpeming. This company has just completed a very large dam on the Dead River, north of Ishpeming, at a cost of probably a million or more to retain the waters of the river for its hydro-electric plant. This dam will, when filled, form a lake fourteen miles in length and will insure power for all the mines of the company on this range as well as supplying current to the cities of Ishpeming and Negaunee. A very liberal snowfall insures the filling of this great dam the coming spring.

The Richmond and Empire mines, located on the Cascade branch of the Marquette range are adding new crushing plants and steam shovels to their surface equipment. They produce silicious ores for which there is a constantly-growing market.

The mines have labor enough for their needs.

Lead-Silver Ore Opened in Custer County, Colo.

Reports from the Wet Mountain Valley, in Custer County, Colo., indicates discoveries of lead-silver ores at Querida and Skek City in quantities that promise the return of old time mining activity to these camps. The ore is said to run from 15 to 20 oz. in silver, and 10 to 15 per cent lead. Operations in this district which led to the new discoveries were undertaken by Illinois and Missouri interests, and are attracting much attention in mining circles.

Anaconda Passes Dividend; Shocks Wall Street but Not Copper Industry

The impossibility of copper mining thriving on a 13c. market is indicated in the passing of its quarterly dividend of 75c. per share on its $150,000,000 capital stock by the Anaconda Copper Mining Co. on Feb. 26.

Wall Street's rank and file was surprised. Anaconda shares broke from a high of 37⅞ to 33½. The weakness in the rest of the market list was especially disturbing in the copper group, Utah showing a loss of a point, Inspiration Copper 1⅝, Kennecott 1⅜, and American Smelting & Refining 2 points.

Passing of the Anaconda dividend is attributed chiefly to the heavy bond interest charges that the company has incurred as a result of its expansion policies, including the acquisition of the Chile Copper Co. and the American Brass Co. These charges now amount to more than $9,000,000 a year.

From the viewpoint of the copper industry the action is logical; costs at Butte are too high for profit with 13-c. copper.

Old Drumlummon Mine Optioned by M. W. Alderson

M. W. Alderson, formerly manager of the Crystal Copper Co., of Butte, and associates have obtained an option on a controlling interest of the stock of the St. Louis Mining & Milling Co., which owns the famous Drumlummon property at Marysville, Mont. The Drumlummon was operated many years ago by Thomas Cruse, under whose direction it produced over $1,000,000 and was then sold to an English syndicate for $1,500,000. Chas. Merrill afterwards retreated the mill tailings by the cyanide process and reaped a substantial profit.

Chino's New Mine Equipment Cost $1,200,000 During 1923

Crawling-Tractor Steam Shovel, Ore Cars, and Locomotives Are Purchased—Electric Shovel Ordered

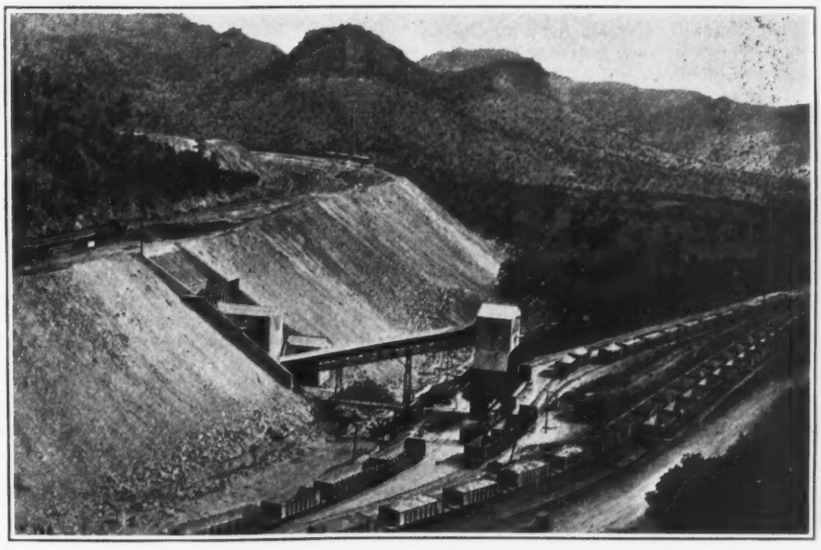
Following its policy of utilizing modern and more efficient operating machinery, the Chino Copper Co. has spent much money recently in the equipment of its mines at Santa Rita. Three new American locomotives of the six-wheel, saddle tank, superheater type were put in service the first of November, these replacing some of the old type four-wheel engines. The new locomotives, of which type there are now nine in service in addition to twelve of the smaller four-wheel type, are of approximately twice the weight and tractive power of those first in use at the mine.

A complete new crawling tractor unit for the model 92 Marion steam shovels arrived about the middle of December. Prior to this time all shovels at the mine were equipped with the standard railroad trucks. The work of removing these trucks from one of the shovels in operation and replacing them with the tractor outfit is now nearly completed.

A new model 92 Marion steam shovel, equipped with the crawling tractor also arrived in December; it is the first shovel of such type to be used at Santa Rita. This shovel first operated in the C. Y. B. pit and soon will be engaged in drop-cut work on that side. Exceptional speed was made in the delivery and assembling of this shovel. Steam shovels at the mine now total twelve—all Marion. However, only eight are actively engaged in loading ore on the day shift, while six are in regular operation at night. An 8-yd. electric shovel has been ordered. This machine will have an 80-ft. boom and four-wheel propelling trucks.

A new compressor to be added to the equipment arrived just before the end of the year; it will be put in operation as soon as a suitable building can be erected and the machinery assembled.

Twenty 30-yd. ore cars of the drop-



Chino steam-shovel ore passes through this primary breaking plant on the way to the concentrator

Magma Smelter Should Be Blown-in in April

The big stack of the new smelter of Magma Copper Co., at Superior, Ariz., is now completed, with the exception of minor jobs to be done, and it now appears certain that the plant will be ready to blow-in early in April. The large stack is 300 ft. high, 37 ft. in diameter at the base and 21 ft. at the top. One unusual phase of the construction of the Magma smelter has been the making of all brick used in the construction at the company's brick plant, which was constructed for that purpose. This has obviated the necessity for securing brick or other material from the coast or other points and has been a saving in many ways.

door type were ordered for delivery last fall but were delayed, at the factory; they are expected early in the year.

Five of the old smaller locomotives were disposed of during the year, these sold to various firms throughout the country who have use for equipment of such capacity; forty old six-yard dump cars were sold and shipped to old Mexico to be used in mining operations in the state of Sonora.

Additions to and replacements in equipment in the offices and shops make a total sum of about $1,200,000 expended during 1923.

With practically all of its old equipment overhauled and put into first class working condition, in addition to the new machinery; with most of the workers familiar with their duties and with efficient staff to oversee and direct the work it is reasonable to expect that the unit cost of mining ore in Santa Rita will be appreciably less in 1924 than in the year just past, provided the tonnage is maintained or increased.

Good Ore on Deeper Levels of Republic, Wash., Mines

The Republic district in Washington is the scenes of new activity in exploration and development at depth. Among the companies that are opening new levels are the Last Chance which is sinking from the 700 to the 900 level. At the Knob Hill mine the Balaklava Mining Co. has recently completed sinking to the 1,000 level. The Quilp and Surprise are mining also at the 1,000 level. In each case ore with good values in gold and silver has been encountered at the new depths. In the Surprise and Republic mines the values were supposed to be exhausted at from 300 to 600 ft. but deeper exploration has proven that good ore persists at depth. This has stimulated activity among other properties in which it was supposed that the values have quit and resumption of the Golden Eagle, adjoining the Quilp, and deeper exploration in the Republic mine is under way. A recent strike of $60 gold ore in the Republic is attracting wide attention.

Washington News

By Paul Wooton
Special Correspondent

Interior Secretary Relates War Minerals Relief Financial Difficulties

Intimates that an Appropriation Would Mitigate His Embarrassment—Claimants Impatient at Delay in Payments

The Secretary of the Interior has appealed to the chairmen of the committee on mining and on appropriations in the Senate and in the House of Representative for advice in connection with the policy to be adopted in the matter of War Minerals Relief. In view of the fact that the War Minerals Relief Act contains the expressed stipulation that expenditures "shall in no event exceed the sum of $8,500,000," no deficit may be created. For that reason and so that no preference might be given to claimants whose cases happened to have been considered first, all payments were suspended on Oct. 13, 1923.

The Court of Appeals of the District of Columbia has sustained the Supreme Court of the District of Columbia in holding that purchase price of property is within the purview of the Act. The case has been appealed to the Supreme Court of the United States by the Secretary of the Interior but there is the possibility that the lower courts may be sustained. If that were the case, claims for the purchase of property aggregating $3,062,867.50 would have to be considered. The Supreme Court of the District of Columbia, in another case, has held that interest on borrowed capital is reimbursible under the Act. The total amount claimed under that classification is $206,320.30. This is in addition to $453,608.54 claimed for mining rights.

In his letter, the Secretary of the Interior also suggests the possibility that the manufacturers of ferromanganese might not agree with the recent opinion of the Attorney General and may enter mandamus proceedings. If the courts should hold that such losses are legitimate, an additional half million dollars would be added to the total amount which would be payable under the Act. In explaining the situation with regard to the appropriation, Secretary Work says:

"In the 200 remaining unadjusted claims which are before the Secretary (not including 248 claims in which no motion for rehearing under the Amended Act has yet been filed), the total amount claimed is $2,592,276.36. The unexpended balance of the appropriation at the present time, taking into account claims in which net loss has been ascertained but not paid, is $1,738,829.75. There are 248 claims in which no application for rehearing under the Amended Act has been filed. It can not be predicted how many of these may be resurrected. Those in which an award was made under the original Act, and in which purchase price of property and interest were claimed *and denied*, undoubtedly will be pressed if the decisions of the lower courts should be sustained.

"At the present moment a resumption of payment of losses in some form is most desirable if the same can be done under the statute. There is constantly increasing impatience and complaint on the part of those who, months ago, were found to be entitled to an award, but who have received nothing, and the number of such complaining claimants is daily increasing as claims are being investigated and adjusted but not paid. The financial condition of many, it is asserted, is desperate, and a resumption of payments would bring relief to all such and probably would save some from ruin. Also, resumption would permit the labor which is now directed to correspondence respecting deferred payments to be turned to the actual adjustment of claims, from which work it has been diverted. The present situation strongly demands, and I earnestly desire that the small minority of claims now remaining unpaid may be accorded the same treatment which the majority has received. But I feel that, in view of the possibility or probability of a deficit, I cannot resume payments notwithstanding the urgency and that it is my duty to acquaint the chairmen of the proper committees in the Senate and House with the difficulties of the situation."

Tri-State Zinc Operators Will Supply Production Figures

Gold-Silver Commission Wants Data—Important Bearing on Silver Production in the West

Operators in the Tri-State zinc region have agreed to co-operate with the Commission of Gold and Silver Inquiry by making statistical returns which will enable the commission to make calculations as to the influence of production in this district over the production of silver-bearing zinc in other regions. The zinc mined in the Tri-State region has no silver content, but the output there has decided bearing on the production of silver-bearing zinc in other camps.

Senator Oddie, the chairman of the commission, is assuring all operators that there need be no apprehension as to the confidential handling of individual returns. H. A. C. Jenison, who will compile the figures has been instructed that all of the data collected from individual mining companies will be held absolutely confidential and that all such confidential data will be destroyed when the work is complete and the commission furnished with a report containing the summation of all of the individual data so collected.

Senator Oddie points out that the failure of any mining company to respond in supplying the data will greatly impair, if not altogether destroy, the usefulness of the data in determining the condition of the industry as a basis for legislation which the commission may desire to present and he urges the producers to lend their hearty co-operation in this work.

London Letter

By W. A. Doman
Special Correspondent

Mining Interests Not Enthusiastic Over Recognition of Russia

Object to Terms—Britain Failed to Drive a Good Bargain—Something for Nothing

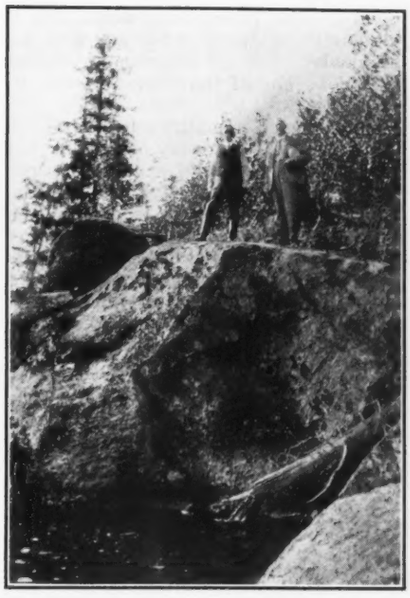
London, Feb. 7.—Since last writing the city has been greatly exercised over the recognition of Russia by our "Socialist" Government. Although the permanent officials remain, it is evident that some amateur hand has been predominant in the document that has been signed. The point is that Great Britain has recognized the Union of Soviets and has received nothing in return. Certain reservations have been made, but to the Bolsheviks, who have pulled and are pulling wires in this country, they mean nothing. The present rulers are out for a loan from Great Britain—which they will not get from the city of London unless they play absolutely straight.

A member of Parliament, speaking at a dinner at Engineers' Club, made one very interesting statement. It was that all the big City creditors of the Soviet Government would probably be prepared to accept long-dated bonds in payment, instead of cash, and the agreement negotiated between the Russo-Asiatic at the hands of Mr. Urquhart and M. Krassin, was on this basis. It was well known and I have mentioned before that negotiations were in progress between the Russo-Asiatic Consolidated and the Soviet Government, but the terms had not leaked out and the City is now wondering whether the £50,000,000 claimed by Leslie Urquhart is to be paid in long-dated bonds, or whether only damages for delays are to be paid and the properties are still to be worked by the company. Leslie Urquhart being in South Africa, official information is not easy to obtain.

Modderfontein East Not Top-Notcher

The Modderfontein East is to be reorganized. Development work has not shown the mine to be a really first class proposition, and it is well known that a grade of ore above the average has been extracted and will be extracted for the next twelve months. Rumor cannot always be trusted, though the Jade is sometimes correct. Hitherto the ore mined has been treated at the Apex mill; it is now proposed to erect a reduction plant of 50,000 tons per month capacity, on the property. The capital is to be written down to £465,465 and two new shares are to be issued for every five old; the outstanding 7 per cent debentures are to be redeemed and 6½ per cent first mortgage debentures for £465,465 convertible into shares are to be issued.

While on the subject of rumor, it may be mentioned that the Simmer & Jack, to be reorganized as the Simmer Mines, is to acquire the claims of the old Simmer Deep, adjacent to the South. The story is that all timber was taken out of the mine, and that the sum to be provided for reopening these southern claims is not likely to prove adequate.



One of the three islands in the Trap Lake soapstone deposit

Record Output for Government Areas

The Government Gold Mining Areas (Modderfontein) earned during January the record profit of £202,270 against £185,481 in December. It is suggested that the shares are to be taken to £8 and then split into £1 shares.

Attempts are being made to revive interest in West African Gold mining. Apart from the Ashanti Goldfields Corporation, the number of successful companies is very few. On the outskirts of the A. G. C. area some capital assays are reported, but further funds are necessary to develop the reefs.

J. H. Cordner-James headed a deputation to S. M. Bruce, Prime Minister of Australia, just previous to the departure of the latter for home, to ask for Government support for Western Australian gold mining. Mr. Bruce is said to have been sympathetic.

J. H. Hammond and J. E. Spurr Endorse Mines Department

Endorsements for the Department of Mines bill continue to reach Senator Oddie. John Hays Hammond has gone on record endorsing the plan in an unqualified way. Senator Oddie also is in receipt of an endorsement of the bill from J. E. Spurr, which reads in part as follows:

"I am very strongly in favor of a Department of Mines and consider it absolutely necessary for the welfare of the mining industries and for the proper prolongation of the general business prosperity of the country. I do not think it should be regarded as a sop to the mining industries but should be considered as a help to the other industries that depend upon the proper conduct of mining, one of the greatest and most important of the basic industries of the country. You may be sure of my enthusiastic co-operation."

Big Soapstone Deposit in Ontario Ready for Development

Situated in Kenora District — Large Outcrop of Good Ore—Excellent Market for Product

An important addition to the non-metallic wealth of the Province of Ontario seems likely with the development at Trap Lake in the Kenora district (200 miles south of Winnipeg) of an extensive deposit of soapstone discovered last winter. According to a report made by F. O. Orr for the Canadian Pacific Railway Co.'s Natural Resources Investigation Department this deposit is remarkable not only by reason of its apparent extent but in that it outcrops from 8 ft. to 15 ft. above the surface and is extraordinarily free from fractures. The absence of stringers of dolomite or other injurious minerals makes the product of the deposit suitable for refractory purposes. The area covered by the deposit is partly on the shore of Trap Lake, but includes three islands contiguous to it, which are, apparently, an extension of the mainland deposit. The largest island (about 7 acres in extent) is that nearest the mainland.. It consists exclusively of fine-grained soapstone.

A block from the northwest corner of this island withstood a temperature of 2,650 deg. F. at the Mines Department at Ottawa. Generally the rock shows few shrinkage cracks and it would be possible in some places to take out slabs 6 ft. square without flaw or crack of any description. This is important as soapstone of fine quality, such as this, is suitable material for electrical switchboards. Mr. Orr's estimate of the amount of soapstone exposed above the water level is no less than 1,100,000 cu.ft. but as it is believed that it will be found to continue as deep as it is possible to conduct mining operations.

Transportation presents no difficulties as there is water navigable for barges and small steamers right from the property to Dryden or Washington, a distance of about 9 miles, and the product can be loaded directly from the barges to cars on the C.P.R. siding.

Paper mills use soapstone blocks to line their furnaces. Owing to its heat-absorbing quality it is used for the discs employed in fireless cookers and for foot-warmers; and it is now to be employed as a center for electric irons; and owing to its resistance to the effect of acids it is also largely used in the manufacture of laboratory and sanitary fittings of all kinds. In powdered form, it is used as a "filler" in the making of paint and in all grades of tar paper and linoleum.

Cripple Creek Gold Production Increased to $421,624

Production of gold in the Cripple Creek district in Colorado for January exceeded by almost $70,000 that of the preceding month, amounting to a gross value of $421,628. The Golden Cycle mill treated 21,000 tons, of an average value of $17 and the Portland mill 13,030 tons, averaging $4.95 in value.

Elkoro Mines Co. Netted $22,704 During Last Quarter of 1923

The Elkoro Mines Co., which operates a gold mine at Jarbidge, in the northern part of Elko County, Nevada, made a gross production during the last quarter of 1923 valued at $112,958.37, with net earnings for this period of $22,704.44. The average value of ore milled was $10.88 per ton. This was the most profitable quarter of the year.

During 1923 the company produced 40,244 tons of ore of an average value per ton of $9.10, with gross recovery of $366,517.07, from which a net profit of $45,727.28 was realized. The grade of ore has improved within recent months due to discoveries and developments and the outlook for 1924 is regarded as very promising.

Hibernia mine, formerly Davis-Daly property, and Anaconda's Nettie mine at Butte

Nabob, with Mill Revamped, Resumes Production

The Nabob Silver-Lead Co., operating on Pine Creek in the Coeur d'Alene district, Idaho, started production on Feb. 15, after several months devoted to making changes and additions to the mill, which included the addition of flotation units for the recovery of both lead and zinc. The mill has a capacity of 150 tons a day, and the improvements were made under the direction of L. O. Proctor, formerly of Elm Orlu mine of Butte. In the meantime important development work was carried on in the mine, with the result that Nabob is in position to maintain steady production. In addition to the excellent market for lead, the Nabob company has contracted its zinc product to the Anaconda company under favorable terms.

Mohawk Has First Unit Equipped With Regrinding Machinery

One of the four heads in the Mohawk stamp mill, in the Michigan copper district, now is equipped with regrinders and with the installation of additional tables, copper recovery should be increased approximately 25,000 lb. per month. The three other heads will be similarly equipped and as a result Mohawk's loss of copper in tailing should be one of the lowest in the district.

Flotation probably never will be adapted to the recovery of copper from amygdaloid tailings because the percentage of metal recoverable would not be profitable. Between 4 and 5 lb. of copper out of every ton of rock stamped is lost in washing, and flotation at best could reclaim only half of this, at a cost which would be prohibitive. Regrinding and rewashing are the most feasible.

Exploitation of Iron Ores Brings Creosote Plant to Utah

A plant is to be built in Utah to produce creosote from the coal-tar by-products of the coke ovens of the Columbia Steel Co. situated between Springville and Provo, about fifty miles from Salt Lake City. The Columbia Steel Company itself proposes to start operations about the middle of April, and the Republic Creosoting Co., which is starting the new industry, expects to have construction completed at the same time. The cost of the plant is placed at between $300,000 and $400,000. The principal product will at first be creosote oil, to be used in the treatment of timber so as to prevent decay.

Treadgold Plans New Merger of Yukon Gold Properties

Advice from Dawson City, Y. T., states that negotiations are under way for the merging of the several subsidiary companies of the Gold Fields of America Co. into one big company and for the acquisition of a number of other claims, totaling in all several thousand. A. N. C. Treadgold, of London, is the principal organizer of the scheme; besides the consolidation of the Northwest Corporation, Burrall & Baird, Granville Power Co. and other concerns, he is endeavoring to include the Klondyke Mines Railway and the Yukon Gold Co. It was Treadgold who consolidated some 75 miles of the best placer ground in the Klondyke, now owned by the Yukon Gold Co.

Extend Lease on Hudson Property at Royston, Nev.

The Canadian Leasing Co. has secured an extension of three years to its lease on the property of the Hudson Mining & Milling Co., at Royston, 25 miles north of Tonopah, Nev. This includes the "Betts" lease, from which production started in Sept. 1922, and from which $70,000 worth of high-grade ore has been shipped to date. The Canadian Leasing Co. has been operating continuously, the principal work being a crosscut to get under a prominent quartz outcrop and a north drift. The crosscut is out over 400 ft. and has about reached its objective, and a raise is to be driven through to surface, about 180 ft., both for development and mining purposes. The north drift has been showing better values, although the vein is narrow, rarely exceeding 20 in. in width, and company engineers believe the drift is entering another oreshoot.

Anaconda Mines Re-grouped Under Four Superintendents

During the past few years the Butte mines of the Anaconda Copper Mining Co. have been divided into three groups, each under an assistant superintendent. W. B. Daly, general manager of the Butte mines of the company, in order to promote efficiency has re-divided the mines into four groups, under the supervision of respective assistant superintendents, as follows:

J. J. Carrigan
Anaconda
Never Sweat
St. Lawrence
Moonlight
Belmont
Steward
Original

John C. Gaul
High Ore
Badger State
Bell-Diamond
West Gray Rock
Mountain Con
Poulin
Lexington
Alice

E. M. Norris
Mountain View
Leonard
West Colusa
Tramway

J. R. Bartlett
Pennsylvania
Berkeley
Silver Bow
Tropic
Emma
Anselmo
Orphan Girl
Nettie

Anaconda Will Soon Own Utah Consolidated, It Seems

Suit has been filed against the Utah Consolidated Mining Co., of Bingham, Utah, by the International Smelting Co., subsidiary of the Anaconda Copper Mining Co. to foreclose a mortgage and collect on a note for $1,276,282. The complaint sets forth that the obligation arises out of the fact that the plaintiff company satisfied a judgment against the defendant company to the amount mentioned. The mortgage executed to secure the note of the defendant company, covers 48 lode mining claims in the Bingham mining district, and ten in the Tooele district. The action recalls the lawsuit between the Utah Consolidated and its neighbor, the Utah-Apex, over apex rights, and at the termination of which the Utah Consolidated was ordered to pay judgment for ore unlawfully extracted from beneath ground owned by the Utah-Apex. The suit was one of the most stubbornly fought in the history of mining litigation.

Situation at the Mines

By Arthur B. Parsons
Assistant Editor

IF 10 were par the following figures should give, in a general way, some conception of the condition of the major metal-mining industries at this writing: Lead 12, zinc 10, iron 10, gold 9, silver 8, copper 6. "Par" would mean that nearly all of the developed and well equipped properties were operating and making a reasonable profit on production. Naturally, such an estimate depends upon the standards used by the individual judge, so that there is plenty of room for difference of opinion. With respect to lead, zinc and copper, the market price for the metal is the most important element. Lead has been rising steadily having increased from 7.7 to 9c. since Jan. 1; zinc has climbed from 6.3 to 6.8c.; and copper after a dip to 12.12 in the middle of January now is around 13c.

Lead Mining Flourishes

The strength of lead, lies in the fact that little apprehension is felt that current mine production will outstrip consumption. Reports clearly indicate growing production. The A. S. & R. Co. is to increase the capacity of its smelter at Tacoma; January established a new high record for the Durango smelter in Colorado where lead is the principal base metal; Utah smelters are receiving larger customs shipments; the Coeur d'Alene mines are running at top notch; and from the Kootenays in British Columbia, twenty-four active mines are shipping. In the Southeast Missouri lead district mining activity recalls the war period when lead sold at 12c. in St. Louis. The National Lead Co., whose crushing plant was destroyed last November, is again producing at maximum capacity. Good ore is being opened on the Pim land. The Annapolis Lead Co., under new management, is milling 500 tons of ore in its remodeled plant. And yet production does not seem to overtake consumption.

With zinc on the other hand, the situation is different. Producers in Oklahoma, the principal field, feel that they are on thin ice because the current output of concentrate, about 14,750 tons per week, represents a surplus over smelter requirements. In the west, zinc production is higher now than it has been.

The present winter season in the Lake Superior iron region is a busy one. Stock piles on the Michigan ranges were largely depleted during the last heavy shipping season, and energy is being directed to rebuilding them in anticipation of another big year in 1924. The Oliver Iron Mining Co. is spending $870,000 on new equipment.

Some gold miners feel that their lot is a hard one, because the price of their product is fixed. On the other hand it may be argued that this is an advantage and that there is no sense in harking back to pre-war standards to complain that operating costs are "too high." Cripple Creek is reviving, thanks to new discoveries; the Homestake maintains its production; and Ontario gold mining is flourishing. The discovery of new ore in the North Star mine and the reopening of the Shawmut mine are good omens in California. If we concede that a new "normal" has been established, gold mining is not so bad.

Operators Are Forgetting the Pittman Act

The same reasoning applies to the silver mines and the readjustment after the Pittman Act, which now is almost ancient history. On the other hand, unlike gold, the possibility of increasing the price of the metal exists, so that there is more room for improvement in the status of silver mining.

Copper is the sore spot. The aggregate mine output is high but the profit is exceedingly low. Moreover many of the companies are drawing upon their high-grade ore deposits and are leaving in the ground low-grade ore that cannot be mined except at greatly increased cost at a future date. This is an unhealthy condition. If they are powerless to increase their revenue the companies can do something toward lowering production costs—and they are. While Anaconda does not confide its mining costs to the public, a report that seems inspired says that the cost of mining, handling and treating copper ore, has in the last few months "been reduced between $1.50 and $2 per ton compared with the average of 1923." This is accounted for in part by a wage-cut in November, and in part by intensive measures for increasing mine efficiency. The decision of Anaconda's directors on Feb. 26 to omit the regular quarterly dividend indicates that, even with reduced costs, Butte copper operations with copper at 13c. are too big a burden to be carried by earnings of Chile Copper, American Brass and the company's various western activities.

The only recent shut-down of importance is the suspension of operations by the Southwest Metals Corporation at its smelter at Humboldt, Ariz. At the same time there has been a tendency to curtail, and it is probable that the current rate of mine output of copper is less than in the final months of last year.

One feature that helps the entire operating situation is an adequate supply of reasonably good miners. Winter, of course, is the period of the year when miners are most easy to get and when a man accomplishes the maximum amount of work. For that reason, seasonal and temporary causes contribute to the present easy situation, but for the moment there seems to be no complaint anywhere on the score of labor. Wages were raised 10 per cent in Southeast Missouri late in the month but the reason was a desire to share prosperity with the workers, rather than to overcome any tangible shortage.

Curtailment of the California Rand company, recently the leading silver producer in the country, to a one-shift basis and the reopening of the Atolia tungsten mine are significant events in California. The United Comstock Mines Co. at Virginia City, Nev., has progressed toward making income and operating costs meet but for the last quarter of the year it reported an operating loss on $3.651 mill heads. Tonopah bullion production increased to $340,000 in February. Utah Copper is averaging 45,000 tons of ore per day at Bingham. Utah. Construction of the new Chief Consolidated mill, at Eureka, is progressing. Discovery of excellent ore in the lower levels of both the Portland and Cresson mines at Cripple Creek, Colo., is important.

New Cornelia Starts 5,000-Ton Concentrator

In Idaho, the Hecla Mining Co. has resumed hoisting and will soon be at capacity. The Nabob and Constitution have mills about ready to resume; they will ship zinc concentrate to the Anaconda plant at Great Falls, Mont. A 16-ft. vein has been cut in the Ajax. The absorption of the Davis-Daly property by Anaconda has ended the apex suit at Butte. Anaconda plans to deepen six shafts to 3,500 ft., the work involving an expenditure of $400,000. The starting of the recently completed 5,000-ton flotation plant of the New Cornelia company at Ajo and the consummation of the Ray-Chino merger, to effect operating economies, are outstanding events in Arizona and New Mexico.

Further rapid development of the Crestline section of the Tri-state zinc district is adding to the output. Three new mills have recently been completed and started. Copper production in Michigan totalled 12,565,000 lb. in February, a slight increase over January and a big increase over December. The passing of Calumet & Hecla's dividend preceded Anaconda's action, the reason assigned being the desire to conserve surplus.

In Northern Ontario, Porcupine produced $2,100,000 in gold during February, a new high record. Nickel output is normal with the International company now up to pre-war capacity. New discoveries are reported from the South Lorrain silver district. The Associated Goldfields has started the construction of a new 400-ton mill on the Crown Reserve at Kirkland Lake.

Reports from Mexico indicate that the "rebellion" is causing no serious dislocation to mining operations. Lead production at the rich Ahumada-Erupcion mines, south of El Paso, Texas, is increasing.

Recent Technical Publications

Reviews, Abstracts, and References

Wherein Engineers Are Often Weak

Public Speaking for Business Men. By William G. Hoffman. McGraw-Hill Book Co., Inc., New York. Price, $2.50.

This is an excellent volume for all business men, or engineers for that matter, who have to or should speak before an audience or a group or a committee, from time to time. The speaking that the author teaches is not the old-fashioned oratory: it is the telling, convincing, brief, and concise message of the busy man of today. How to hold attention; how to be clear and illuminating; how to make hearers understand what one desires to convey: are the central ideas of this plan of instruction. Chapter I, treats of The Right Point of View: Chapter II, of Composing the Speech: Chapter III, of Conduct Before the Audience: Chapter IV, of Training the Speaker's Mind: Chapter V, of the Psychology of Public Speaking: Chapter VI, of Improving the Vocabulary: Chapter VII, of Enunciation and Pronunciation: Chapter VIII, of Practical Grammar and Rhetoric; Chapter IX, of Improving the Voice: and Chapter X, of Common Types of Address.

The book is clearly and entertainingly written; the advice given is not difficult to understand and remember; and the mere reading of it is worth while for anyone who ever has to deliver a speech or present an argument in public. J. E. SPURR.

Mineral Statistics — The Imperial Mineral Resources Bureau has issued several bulletins giving mineral statistics for the years 1919, 1920 and 1921. In general, these statistics cover world's production, exports and imports of the principal countries, and prices. The various bulletins recently issued, with the postpaid prices at which they are sold, are as follows: "Abrasives," 1s. 6½d.; "Antimony," 1s. 7d.; "Barium Minerals," 1s. 3½d.; "Bismuth," 9½d.; "Cadmium," 6½d.; "China Clay," 1s. ½d.; "Chrome Ore and Chromium," 1s. 1d.; "Diamonds," 1s. ½d.; "Fluorspar," 6½d.; "Graphite," 1s. ½d.; "Gypsum," 1s. 7d.; "Magnesite," 1s. 10d.; "Mica," 1s. ½d.; "Monazite," 6½d.; "Nickel," 1s. 6½d.; "Phosphates," 2s. 7d.; "Quicksilver," 1s. ½d.; "Strontium Minerals," 6½d.; "Talc," 9½d.; "Titanium," 6½d.; "Tungsten," 1s. ½d., and "Uranium (Radium) Minerals," 9½d. Any of the bulletins may be obtained for the price named from H. M. Stationery Office, Imperial House, Kingsway, London, W. C. 2, England.

Microscopic Work — A five-page article in *The Iron Age* for Feb. 7, (New York City; 25c.) abstracts a paper on "Conical Illumination in Metallography." The chief advantage is ability to bring out depressions and elevations in the crystal formation which are entirely indistinguishable by direct illuminating methods.

Ore Dressing—A complete survey of the condition of research in the milling and concentration of ores and non-metallic minerals has recently been made under the supervision of D. A. Lyon of the Bureau of Mines, in co-operation with the Milling Committee of the A. I. M. E., the Massachusetts Institute of Technology, and the University of California. The report has been issued as a 48-page bulletin in mimeographed form, copies being available from the U. S. Bureau of Mines, at Washington, D. C. This report is the best available record of what is going on in the various ore-reduction and concentration plants of this country and Canada and should prove of wide interest to metallurgists and millmen. Not many details of practice are given; for these the inquirer must depend upon the technical press, correspondence, and personal contact; but he will at least know where to go for information, and have a general idea of how most of the present-day problems are being solved. A great deal of research work is being done in the mining industries but most of it is in an effort to solve local problems rather than to determine basic principles and compare the efficiencies and applications of different types of machines. To this field, the Milling Committee of the A. I. M. E. and the Bureau of Mines may well devote some of their energies.

Patents

Concentrating Carnotite—No. 1,478,631. Dec. 25, 1923. W. F. Bleecker, Boulder, Colo. Carnotite ore is treated with combined sulphuric and hydrofluoric acids until the radium-bearing mineral, in a substantially solid condition, is loosened from the sand, from which it is then separated by mechanical means.

Selective Flotation — No. 1,478,697. Dec. 25, 1923. G. A. Bragg, Salt Lake City, Utah, assignor to Metals Recovery Co., New York City. Selective flotation of sulphide minerals is accomplished in a slightly alkaline pulp containing a small amount of a soluble sulphite.

Sulphate Roasting — No. 1,478,790. Dec. 25, 1923. P. R. Middleton, New York City, assignor of one-half to J. C. Lalor, New York, Willard A. Lalor, executor. Sulphide ores are heated with access of air to a reacting temperature below the ignition point of sulphur. The ore is held there until the maximum proportion of the sulphur has been oxidized to sulphate. Thereafter a portion of the sulphate is decomposed to establish the desired acid balance.

Ore Reduction—No. 1,478,822. Dec. 25, 1923. J. D. Gat, North Canton, Ohio. Ore containing a metal capable of forming an oxide of acid reaction is immersed in a bath containing an alkali metal. Molten metallic compounds are thereby formed which are withdrawn and separated from each other.

Ore Concentrator — No. 1,480,466. Jan. 8, 1924. P. F. Reinhart, Meriden, Conn. A machine comprising a casing in which a suction is maintained, and on which is mounted a rotating drum for concentrating ore.

Centrifugal Gold Washer — No. 1,478,761. Dec. 25, 1923. G. E. C. Rousseau, Sacramento, Calif., assignor to Rousseau Gold Washing Machine Co. A centrifugal washer for separating gold from sand. A current of water is delivered against the normal discharge of the gold to prevent escape of foreign matter.

Cyanide Precipitant—No. 1,479,542. Jan. 1, 1924. Wilhelm Hirschkind, Los Angeles, assignor of one-half to International Precipitation Co., Los Angeles. Gold, silver, or other metal is precipitated from cyanide solution by adding thereto sodium hydrosulphite.

Leaching Copper Ore—No. 1,480,059. Jan. 8, 1924. W. E. Greenawalt, Denver. The process comprises leaching copper ores with an acid solution of ferric iron, generating hydrogen sulphide from acid and ferrous sulphide, precipitating the copper from the leach solutions with the hydrogen sulphide so formed, adding the ferrous sulphate formed in the generation of the hydrogen sulphide to the leach solutions, electrolyzing the ferrous iron in the leach solution in the presence of the regenerated acid to convert the ferrous iron into the ferric condition, and then applying the regenerated ferric iron solution to the ore.

Saturating Liquid with Gas — No. 1,480,060. Jan. 8, 1924. W. E. Greenawalt, Denver. A method of saturating liquid with gas by means of a rotating mechanism operating in a sealed chamber.

Hydrometallurgy of Lead — No. 1,480,110. Jan. 8, 1924. M. G. Platten, Salt Lake City, Utah. Crushed ore is leached in a saline solution, the lead content being precipitated by metallic iron. The iron and lead are them melted to effect the desired separation. This process is the one used at the Tintic Standard plant.

Reducing Nickel from Oxide — No. 1,480,212. Jan. 8, 1924. J. deF. Lamothe, Paris, France. A process of reducing metallic nickel from impure nickel oxides.

Introducing Blast-furnace Fuel—No. 1,480,434. Jan. 8, 1924. E. N. Goode and M. J. Johns, Mount Morgan, Queensland, Australia. A device for introducing fuel into a blast furnace below the level of the charge but above the tuyères, by the use of a reciprocating plunger operating in tubes placed in the sidewalls of the furnace.

Chloridizing Leaching—No. 1,480,439. Jan. 8, 1924. H. J. E. Hamilton, North Broken Hill, New South Wales, Australia. The ore is first subjected to a selective chloridizing roast at a temperature below or approximating 400 deg. C. in an open furnace to which the air has free access. It is then leached in a boiling or hot solution of an alkali chloride such as common salt, and the resulting solution is subjected to the action of a metallic precipitant to deposit the lead and silver.

MEN YOU SHOULD KNOW ABOUT

Frank D. Pagliuchi is in Venezuela.

E. P. Crawford is at Guanajuato, Gto., Mexico.

H. R. Edwards, mining engineer, returned from Nome, Alaska, recently.

George T. Coffey, resident manager of the Yukon Gold Co., Dawson, Y. T., is in San Francisco.

J. A. Burgess, of San Francisco, has been in Mina, Tonopah, and Goldfield on professional business.

J. Edgar Pew, of Dallas, Texas, vice president and general manager of the Sun Co., is spending his vacation in California.

David Morgan has returned to Los Angeles, having completed his inspection of the Verde Central property in Arizona.

Gibson Berry, superintendent for the Round Mountain Mining Co., operating at Round Mountain, Nev., is in San Francisco.

Col. A. E. Humphreys, president of the Boyd Oil Company, was in Dallas, Texas, recently, and returned to his home in Denver, Col.

D. D. Moffatt, assistant manager for the Utah Copper Co., is at the Braden mine, at Rancagua, Chile. He will remain several months.

C. B. Kingston is returning to England this month after an absence of eight years in Rhodesia. He expects to visit Canada in the near future.

Howard Bridgewater, of Toronto, who represents the British interests in the Porcupine Davidson mine, was in New York on business last week.

F. H. Brownell, vice-president of the A. S. & R. Co., has made a circuit of the company's plants in the United States. He returned to New York Feb. 22.

Morris Roche has been appointed manager of the Idaho-Maryland mine at Grass Valley, Calif., succeeding **John A. Fulton** who recently resigned.

H. A. Guess, of the American Smelting & Refining Co., has gone to Trujillo, Peru, where the company has mining property and where a small smelting plant may be built.

F. W. Bradley entertained the members of the San Francisco Section of the American Institute of Mining and Metallurgical Engineers at his home on the evening of Feb. 20, 1924.

J. H. Warner, of Denver, representing the East Butte Mining Co., has been in Tonopah to look over conditions in the western part of the district, where his company is interested.

J. Howard Flint has returned to Athens, N. Y., after completing special experimental chemical engineering work in the nitrate pampa of Chile. He has been at the test plant of the Oficina Cecilia.

William E. Cain, formerly drilling superintendent for the Atlantic Oil Producing Co. at Mexia, Texas, has resigned to take the position of general superintendent of the Boyd Oil Co., Col. Humphrey's new organization.

Julius Sanchez, geologist, who has been doing mineral land classification work for the State of New Mexico, will in the near future enter the employment of the U. S. Bureau of Mines in the capacity of geologist on petrographic work.

Herbert Lyon, geologist, reached Los Angeles on Feb. 6 from the Philippines where he has been prospecting for some years.

Frederick G. Clapp is in Australasia engaged in professional work for Australian parties over a period of several months. He has already spent some weeks in New Zealand in company with his clients.

Frederick G. Clapp

Captain Charles J. Gribble has been appointed to take charge of the Davis mine, at Ironwood, Mich., succeeding the late **Captain William Newby.** Captain Gribble comes from the Pabst mine, where he has been assistant captain since his old mine, the Atlantic, at Iron Belt, Wis., closed down.

Charles Stewart, Canadian Minister of Mines, officially opened the plant of the Hamilton By-Products Coke Ovens, Ltd., at Hamilton, Ont., on Feb. 4, where an experiment was carried out under the supervision of government experts to test the coking qualities of several carloads of bituminous coal from the Nova Scotia and New Brunswick mines.

Walter W. Scott, deputy supervisor for the Bureau of Mines of oil and gas operations in the Gulf Coastal district, has been transferred to a similar position in the Rocky Mountain division, with headquarters at Casper, Wyo. **H. B. Hill,** engineer in charge for the Bureau of Mines at the Salt Creek, Wyoming, office, will succeed Mr. Scott on the Gulf coast.

Franz Beyschlag, for forty years president of the Geological Survey of Prussia and of the neighboring Federal States, has retired from his post. He rendered valuable services to German geology, especially in regard to the study of ore deposits. Under his direction the Geological Survey issued a great number of geological maps, reports, and monographs. He developed the geological survey of Prussia to a well-organized scientific and technical research board. Beyschlag is the author of a well-known textbook of economic geology and the editor of the *Zeitschrift für praktische Geologie.* His successor is **Paul Krusch,** till now director of the geological survey of the mountains.

Prof. Arthur L. Walker, of Columbia University, has returned from visiting large copper mines and metallurgical plants in Chile, South America. He crossed the Andes in the middle of their winter (Aug. 1); then crossed the Atlantic and visited the Rio Tinto copper mines of Spain; then to India visiting the old ruined temples and tombs of the King, then through northern India down to the Malay Strait Settlement, where most of the tin of the world is produced; then to China, up the Yangtze River, to the large iron and steel plants in the vicinity of Hankow; then across the Pacific to Seattle, arriving here in time for the spring session at Columbia.

Dr. Thomas T. Read, supervising mining engineer of the U. S. Bureau of Mines, has been awarded a gold medal and a commemorative diploma by the Government of Brazil. Dr. Read was the representative of the Department of the Interior with the United States commission to the celebration of the 110th anniversary of the independence of Brazil, at Rio de Janeiro, last year, and was also the special delegate of the American Institute of Mining and Metallurgical Engineers and the Federated American Engineering Societies to the international engineering congress held in connection with the celebration, which was attended by an American delegation headed by Secretary Hughes.

Tom F. Coyne, of Webb City, Mo., was elected governor of the Tri-State branch of the Amercian Mining Congress, at the annual election held at Picher, Okla., in January. He succeeds **Sidney H. Davis,** who has been made president of the Tri-State branch of the American Zinc Institute. Coyne is one of the veteran operators of the district and formerly was an extensive producer in the soft ground field around Joplin and outside the sheet ground area near Webb City. **John W. Newton,** of Picher, was elected vice-governor for the organization for Oklahoma; **P. B. Butler,** of Joplin, for Missouri; and **J. G. Trewartha,** of Baxter Springs, for Kansas. Directors for the year are **Coyne, Butler, A. E. Bendelari, F. N. Bendelari** and **O. W. Bilharz.** The secretary will be appointed by the president.

OBITUARY

B. L. Knowles, manager of the publicity department of the Worthington Pump & Machinery Corporation, died Feb. 14, as a result of a cerebral hemorrhage. Mr. Knowles was forty-five years old at the time of his death and had spent twenty-eight years with the Worthington Corporation.

New Machinery and Inventions

Drilling Deep Holes with Hammer Drills and Sectional Drill Rods

Low Costs Obtained by This Method of Prospecting from Drifts, Crosscuts and Other Underground Workings

By Howard R. Drullard
Denver Rock Drill Manufacturing Co.,
Salt Lake City, Utah

A NOVEL development campaign by which extensive prospecting is being done with rock drills and sectional drill steel from drifts, crosscuts, raises and stopes has been inaugurated by the Chief Consolidated Mining Co., of Eureka, Utah. The new method is proving highly satisfactory as to costs and time required to obtain a given amount of information. As the silver-lead ores of this mine occur in rather irregular bodies found in three favorable limestone formations, prospecting and development are of first importance. That marked economies can be made and much ore located by the new method has been proved and its use is being expanded rapidly.

The progress made in developing the equipment used is interesting. From the information at hand it appears that the Elm Orlu Mining Co., of Butte, was among the early users of sectional rod. In 1916, a 45-ft. horizontal hole was driven from the top of a raise to connect with and drain their East shaft. The raise being rather small, 2-ft. sections of rod made from 1½-in. pipe were used, one piece being welded to a regular drill shank, the remaining sections having pipe threads on both ends. The necessary sleeves were provided for coupling the rods together as in ordinary pipe fitting, with the exception that the threads were cut to permit the pipe meeting end to end. Bit ends were threaded to fit the sleeves. The hole was drilled in altered Butte granite and the shaft drained.

The Anaconda Copper Mining Co. developed the method still further and drilled holes to a depth of 90 ft. through altered granite and gob. Diamond-drill "E" rod was used instead of pipe, and a water-connection swivel employed to introduce water directly into the rod, rather than through the rock-drill as previously, for it was found necessary to use rather high and direct water pressure to expel the cuttings from the deep drill holes.

In 1922 the North Butte Mining Co. started the use of deep rock-drill holes for prospecting from drifts, crosscuts and stopes. Hard granite was encountered and it became necessary to use still heavier rod. The "E" rod was abandoned and regular 1¼-in. hollow round drill steel used in its stead. To maintain the maximum section of the drill steel, it was necessary to upset each end of the rod to 2 in. in diameter and machine a taper male thread on one end, with a corresponding female thread on the other. The rods were screwed together and their use proved to be satisfactory mechanically, although the accurate threading of the high-carbon drill steel in a lathe was rather difficult.

During the latter part of 1923, the campaign of deep hole prospecting referred to was entered upon by the Chief Consolidated company and carried out by the Walter Fitch Jr. Co., contractors, Eureka, Utah. As already stated, the results of this campaign have been satisfactory and the use of the method is being rapidly expanded. Normally, 12 miles of development work is done annually in the Chief Consolidated mine, and, as this consists largely of crosscuts, much of this work can be done by drill holes at a pronounced saving.

Standard Equipment Used Chiefly

The present equipment conforms closely to that used in standard mine practice and consists of a rock drill, 3-in. single screw columns, arms and saddle, 1-in. air hose, ¾-in. water hose, drill bits, threaded drill rods, sleeves and water-connection swivel. These items, except the last three, are standard mine equipment. The equipment being of first importance, it is well to review each item in detail:

Rock Drills. Model 34 and Model 31 "Waugh" independent-rotation Turbo drills, made by the Denver Rock Drill Manufacturing Co., are used. As the burden thrown on the rotating mechanism of the machines is pronounced, both in drilling and in withdrawing the steel from tight holes, the use of independent rotation drills is primary. The Model 31 Turbro has been used on holes up to 100 ft. in depth. This drill weighs 143 lb. and is fitted with a 3-in. piston hammer. The Model 34 Turbro, weighing 225 lb. and using a 4-in. piston hammer, has proven, however, to be better adapted to this work by reason of its greater power and reversible rotation which enable the operator to unscrew as well as screw up the rods by use of the machine.

Column. As shown in the illustrations, single screw columns can be used with the machine attached directly to the column or mounted on a double-headed arm between two columns. Experience has shown that this double-column set-up is by far the better, as it permits proper alignment of the drill and is much more rigid, with the result that drilling is much faster (see cover).

Arms. The double-headed arm can be made up at any mine equipped with a welding torch by welding two standard arms together. The overall length of the double-headed arm should be about 2 ft. 6 in. so it is advisable to shorten one arm to the proper length before welding, thus locating the weld at one side of center. A piece of pipe fitted inside the arms reinforces this construction.

Saddle. Any standard saddle.

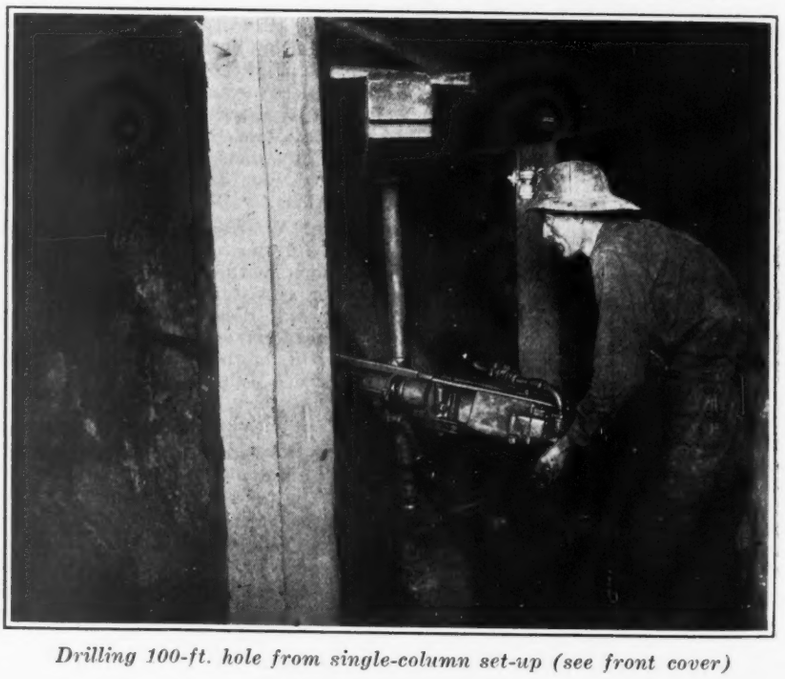
Air Hose. Any standard 1-in. hose.

Water Hose. Should be capable of withstanding 250-lb. pressure. Size ¾ in.

Sleeves. The sleeves are made by the Denver Rock Drill Manufacturing Co. from steel and are correctly heat-treated. Special tooling equipment is required for threading them.

Water Connection Swivel. By reference to the sketch in Fig. 2, the detail of the swivel will be readily understood. This swivel is used on all holes drilled with the drifting machines. When drilling with stopers, a thrust bearing is added to the swivel; this will be explained later in this article.

Threaded Drill Rod. The design of the rods, as well as the equipment for



Drilling 100-ft. hole from single-column set-up (see front cover)

forging the thread and collar, has been developed by the Denver Rock Drill company. This detail is shown in Fig. 1. The forging operation is quite simple; in fact, more so than the forging of an ordinary lugged shank. After forging, the ends of the rods are trued up in a lathe and hardened by the same treatment as given drill shanks, that is, heated to 1,500 deg. F. and quenched in oil.

Bits. Double-taper cross bits ranging from a 3¼-in. starter down to a 2½-in. finisher with ¼-in. decrement of gage per bit have been found satisfactory.

For drilling a 50-ft. hole between 5 deg. and 45 deg. above the horizontal the following equipment in addition to the rock drill would be required:

6—3-ft. lengths 1¼-in. Waugh threaded drill rod.
6—6-ft. lengths 1¼-in. Waugh threaded drill rod.
12—Waugh threaded drill rod sleeves.
7—Waugh bit ends 26-in. long in the following gage sizes: 3¼ in., 3⅛ in., 3 in., 2⅞ in., 2¾ in., 2⅝ in., and 2½ in.
1—Waugh water swivel connection.
1—Waugh lugged and threaded drill shank.
2—3 in. x 6 ft. single screw columns.
2—3 in. arms.
1—3 in. saddle.
1—50-ft. length 1-in. air hose with connections.
1—50-ft. length ¾-in. water hose with connections.

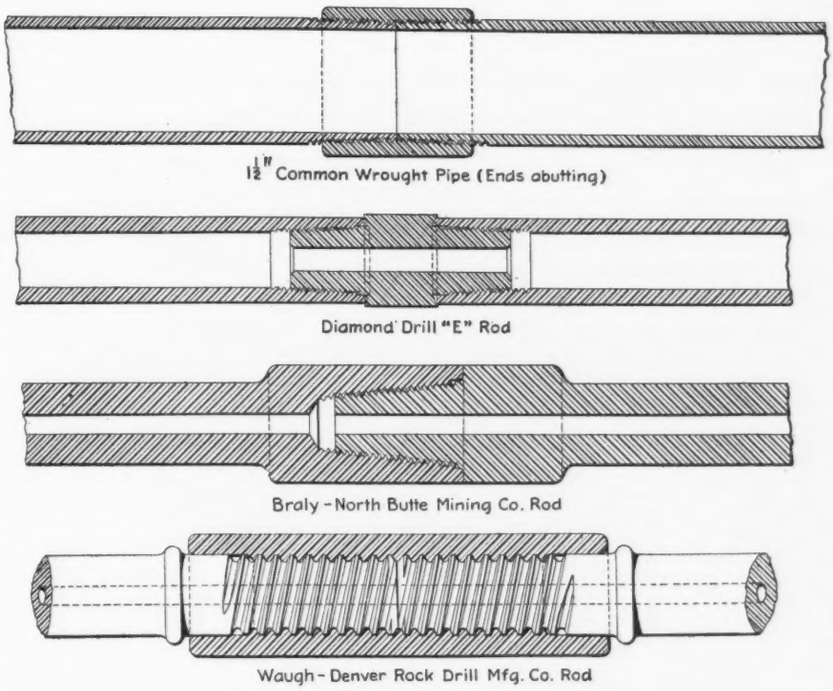

1½" Common Wrought Pipe (Ends abutting)
Diamond Drill "E" Rod
Braly - North Butte Mining Co. Rod
Waugh - Denver Rock Drill Mfg. Co. Rod

Fig. 1. Evolution of sectional drill rods

Geologist Should Supervise Work

To obtain maximum results in ore discoveries, a careful study of the geology should be made and the holes drilled under the supervision of the geologist or whoever is in charge of the mine development. Exceedingly hard formations are to be avoided as will be mentioned later.

The column should be placed so as to put the arm 4 ft. from the collar of the hole; this permits of a full 3-ft. run and allows room for the swivel. A good rigid set-up is markedly advantageous. The machine is then mounted in the conventional manner except that, as no water is passed through the machine, the water tube has been shortened by 2 in. and the common water spud is replaced by a plug. The water hose is connected to the water-connection swivel. A bit end is screwed into the swivel and drilling begins. The steel should be kept in good alignment with the hole during the first 8 or 9 ft. of drilling. After the bit end is run out, the independent rotation on the machine is reversed and the joint unscrewed by the rotation mechanism, the bit end remaining in the hole. The machine is then cranked back and a 3-ft. drill rod is held between the swivel and the bit end in the hole and screwed up by the independent rotation running in its normal direction. Drilling proceeds in this manner until the bit becomes dulled, whereupon the clamp of the saddle is loosened, the machine turned to one side and the rods withdrawn and disconnected. The second (3¼-in.) bit end is screwed into a sleeve on a 6-ft. rod and placed in the hole. Additional 6-ft. rods are added until the bit reaches the end of the hole. Drilling is resumed and 3-ft. rods are added as the hole progresses; when the second bit becomes dull, the change is repeated.

To date the breakage of drill rods has been almost negligible but fishing tools have been developed by the manufacturers of the drill rod whereby a broken section in the hole may be withdrawn.

In drilling holes slightly above the horizontal to a depth of from 50 to 75 ft., water under 70 lb. will eject the cuttings satisfactorily but when drilling deeper holes or holes below the horizontal, higher pressures must be used. These may be obtained by tapping the pump column, if there is sufficient head in the shaft, or by the use of a small high-pressure pump. From 3 to 5 gal. of water per minute are required, depending upon the pitch of the hole and the hardness of the ground.

When gravelly ground is encountered, it is sometimes necessary to blow out the holes, although this is not often the case on 50-ft. holes drilled above the horizontal.

Care should be exercised in coupling the rods so as to insure each rod meeting end to end. The sleeves are not expected or designed to transmit the energy which flows directly through the drill rods. This brings up the question of how the energy from the piston hammer is transmitted to the drill bit.

One hole was drilled to a depth of 227 ft., as illustrated by the photograph on the front cover. All the steel and couplings shown were used in the hole at one time and as the rods and couplings weighed about 900 lb., it is obvious that the entire rod was not moved by each blow of the 14-lb. piston hammer but rather that a flow of high frequency vibrations was transmitted through the rod and was expended by the action of the drill bit against the rock. This is borne out by the fact that the drilling speed per minute on the last 50 ft. of this deep hole was practically the same as on the first 50 ft., the slowest rate of drilling being between the 75 and 100-ft. points.

Three-Foot Samples Taken

The cuttings are caught in a sample pan as they flow from the hole and individual samples are taken of each 3 ft. of hole, the sample pans being changed each time 3 ft. of hole is drilled. As the sole purpose of the hole is to prospect the ground, close supervision of the sampling is advisable. In addition to the drilling already described, holes have been drilled to a depth of 75 ft. at an angle of 70 deg. to 72 deg. above the horizontal with a Waugh self-rotating stoper. It is, of course, obvious that the drill rod must be counterbalanced in order that it may be held firmly to its work. A swivel connection, similar to the one already described but equipped with a thrust bearing, has been worked out. A small cable is attached to this swivel,

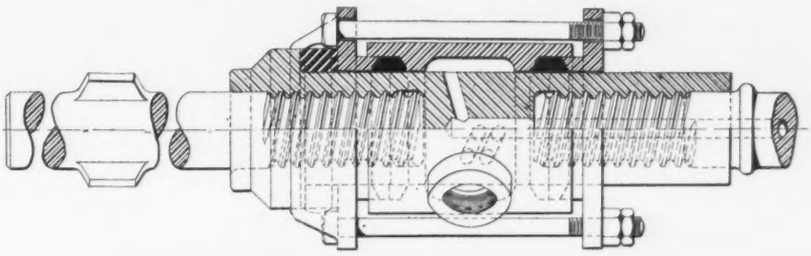


Fig. 2. Waugh-Denver Rock Drill water swivel

passes over a sheave above the machine and is attached to an empty carbide can. As the drilling progress and rods are added, sufficient rock is thrown into the can to counterbalance the weight of the drill rod. Another small cable is used to hold the rod up in the hole when sections are added.

The orebodies of the Chief Consolidated mine occur in limestones of moderate hardness, although narrow ribs of rather hard quartzite are occasionally encountered. The character of the formation is such that from 10 to 20-ft. of drilling can be accomplished with one bit. Vugg holes are frequently encountered but do not present any serious difficulty. In this formation it is not unusual for two men to drill the first 50 ft. of a hole in one shift and 30 ft. the following shift. However, from this point on, the drilling accomplished each shift decreased rather rapidly due to the time required to withdraw the rod and replace it in the hole when changes of bits were necessary. The 227-ft. hole required 16.5 shifts with two men. The costs of the work can be estimated from the foregoing and they are low.

Orebodies were encountered in twelve of the first forty-eight deep holes drilled. Ore is now being mined from four of these bodies and crosscuts and raises are being driven, or will shortly be driven to all of these deposits. The ore found by one hole has already more than paid for all the drilling to date.

Sectional drill rods can be used for purposes other than prospecting particularly the draining of water courses and old workings ahead of development faces. Open-cut mining in quarries using deep holes will probably present a field for the new method.

It must be borne in mind that the depth of hole that can be drilled is limited by certain factors, the principal one being the wear on the gage of the drill bits, for it is evident that if each bit can drill but 1 ft. and only seven changes are available, the result would be a 7-ft. hole. However, under favorable conditions, 6 ft. or more can be drilled with each bit and, this being the case, deep holes disclosing much valuable information can be drilled quite cheaply. The application in each individual case is a matter that must be decided by the mine management.

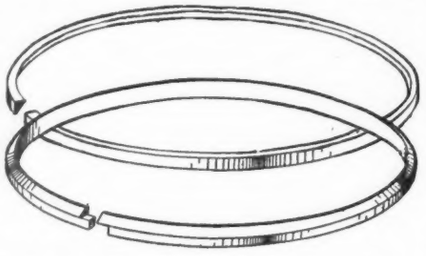
Cecil Fitch, manager of the Chief Consolidated Mining Co., who inaugurated this campaign of prospecting, as well as the Walter Fitch Jr. Co., which is carrying it out, under the supervision of John Matheson, are to be credited with the results achieved. It is interesting to note that the Walter Fitch Jr. Co., with Mr. Matheson as superintendent, established the world's shaft-sinking record of 427½ ft. in thirty-one days for which they were awarded the *Engineering & Mining Journal* shaft-sinking medal.

Self-cleaning Grizzly

In the description of the Nelson self-cleaning grizzly on p. 307 of the *Journal-Press* of Feb. 16, the author's statement that the grizzly is patented by Guss Nelson, of Douglas, Ariz., was accidentally omitted.

A New Piston Ring

Recently there has come to notice a new piston ring that is of two-piece construction, having an inner or expansion ring and an outer or packing ring. A special analysis iron is used, which after having been thoroughly seasoned is further improved by a special re-turning process on the expansion ring, producing what is termed an "even-radius"-type ring, having equi-radial expansion every 30 deg. on the entire circle, all points having equal pressure. This is beneficial in slightly out-of-round cylinders. A non-clogging



Piston ring of two-piece construction

oil wiper is also provided in this section of the ring.

The outer or packing section is of softer non-resilient iron, being turned with an inner surface on a 55-deg. angle, the expansion ring having an externally inclined face of the same angularity, thereby relieving groove pressure and increasing pressure on the circumference, lengthening the life of the expansion ring. An effort is being made to eliminate draw-backs such as deepening of ring grooves, drilling of pistons, oil regulations, springs, pins or other objectional features. The manufacturer is the Kendell Motor Products Co., Fort Wayne, Ind.

Governs Boiler Pressure Automatically

The General Electric Co. is now marketing a new and improved type of pressure controlled speed regulating panel for automatically governing boiler steam pressure by the control of the speed of the motor-driven forced draft blower. This new device is known as the CR-7731-A1, and is similar to the type which it supersedes, with the exception of a notching attachment, furnishing a definite graduated movement of the motor controller.

The previous type panel incorporated a compensating feature requiring a continued increase or decrease in pressure to move the controller through its entire range. In addition to this feature, the new type has a pilot valve controlling the movement of the main plunger which, in turn, moves the pilot valve back to a neutral or cut-off position, at each of a series of definite or stepped positions. At the same time, a counteracting force is applied to the scale beam which requires a new pressure valve to be set up before the pilot valve will again operate. This gives a step-by-step action to the motor controlling switch which has a number of points corresponding to the number of notches provided on the pressure regulator.

TRADE CATALOGS

Rock Drills—For over a year the Sullivan Machinery Co., Chicago, Ill., has had under test its new differential valve water drifting drill, Class DW-64. This is a 130-lb. machine, and may be operated by one man if desired, but is intended for heavy as well as light tunneling and drifting work, and in actual practice has exceeded the expectation of the designers in being able to handle long holes, and heavy steel, in all kinds of ground, with increased drilling speed, convenience and air economy, as compared with two-man drills weighing from 40 to 100 lb. more. Bulletin 81-C, issued in August, but not released until recently, describes the details of the machine.

Shovels—Three catalogs have been received from the Bucyrus Company, South Milwaukee, Wis. One of these describes the 30-B steam shovel, dragline, clamshell excavator and crane; another the Bucyrus 20-B Diesel shovel, dragline excavator, clamshell excavator and crane; Bulletin F-302 describes the Bucyrus 30-B shovel, dragline excavator, clamshell excavator and crane, operated either by a full Diesel or a gasoline engine.

Flexible Couplings—Bulletin No. 37 issued by Smith & Serrell, Central Ave. at Halsey St., Newark, N. J., covers Francke flexible couplings for direct-connected machines. These couplings are made by John Waldron Co., New Brunswick, N. J., for whom Smith & Serrell are sales agents. On pages 20-21 is shown a new high-speed flexible coupling for geared-turbine and for high-speed motor drives, and on page 24 a new pressed-steel flexible coupling for little auxiliary drives.

Wire Rope—The Macwhyte Company, Kenosha, Wis., has issued an 80-page illustrated book on wire rope. Primarily a catalog it gives much information of value relative to wire rope and accessories.

Belt Fasteners—A service chart covering belt joining has been prepared for free distribution by the Crescent Belt Fastener Co., 247 Park Avenue, New York. It is designated Form N.Y. 298.

Drawing Instruments—A 32-page catalog, C-24, of "American-made" drawing instruments has been issued by the C. F. Pease Co., 871 North Franklin St., Chicago, Ill. The company will furnish copies on request.

Road Machinery—A 4-page leaflet describing the Austin "Plain-tainer," a device for maintaining roads in condition, is being distributed by the Austin-Western Road Machinery Co., 400 North Michigan Avenue, Chicago, Ill. A folder describing the Austin "Pup," a road maintainer and roller for all-around purposes, which is handled by the same company, is also being distributed. Catalog No. 24, of 64 pages, describing the complete Austin-Western line of road machinery has also been received.

THE MARKET REPORT

Daily Prices of Metals

Feb.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
21	13.00	53.75	54.25	8.70	8.75@9.00	6.80@6.85
22	.....	.....	.....	....	.....	.....
23	12.875	52.75	53.25	8.70	8.75@9.00	6.80@6.85
25	12.75	53.625	54.125	8.70@9.25	8.75@9.00	6.80@6.85
26	12.75	54.375	54.875	8.70@9.25	9.00	6.775@6.80
27	12.875	54.375	54.875	9.00	9.125	6.80
Av.	12.850	53.775	54.275	8.870	8.950	6.813

*These prices correspond to the following quotations for copper delivered: Feb. 21st, 13.25c.; 23d, 13.125c.; 25th and 26th, 13.00c.; 27th, 13.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
21	63 5/8	64 1/2	69 3/4	278	275 5/8	35	34 1/4	37	36 3/8
22	62 7/8	63 5/8	69	274	272 1/4	35 1/4	34 3/8	37	35 3/4
25	63 1/2	64 3/8	68 3/4	275 1/4	274 3/4	35 3/8	34 1/2	37 1/8	35 7/8
26	63 3/8	64 3/8	69	280 3/4	279 1/2	35 3/4	34 3/4	37 1/8	36 1/4
27	65	65 5/8	69 1/2	280 3/4	279 1/2	36 1/8	35 1/4	37 1/2	36 3/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver		Gold London	Feb.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
21	4.31 1/8	64 1/4	33 7/16	95s 9d	25	4.31 1/8	64 1/8	33 5/16	95s 8d
22	.....	....	33 9/16	95s 8d	26	4.29 1/8	64 1/4	33 3/8	96s 0d
23	4.31 1/8	64 3/8	33 9/16	.....	27	4.29 3/8	64	33 3/8	96s 3d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Feb. 27, 1924

None of the non-ferrous metals have been in very active demand during the last week with the exception of lead, the scarcity of which continues unabated. Copper and tin have been exceptionally quiet, and the demand for zinc has not been so great as in the last few weeks. The London market is firm on practically all of the metals however, and this is a good influence.

Copper

Purchases of copper during the last week have been the smallest for some time. Of course, there was no buying on Washington's birthday, Friday, and the news that Calumet & Hecla and Anaconda had passed their dividends hardly served to stimulate buying. Many of the producers are quoting nominal prices, up to 13½c., delivered, being content to stay out of the market at present levels. Two or three interests have been willing to sell small tonnages as low as 13c. during the last two or three days, and the amount thus offered has been more than enough to take care of the meager inquiry. The slight advance reported today is caused entirely by the increase in London for it is much more profitable to sell for export, than to domestic consumers at 13c. Though the foreign demand has not been extremely large, it has been sufficient to take the pressure off the domestic market, and it is unlikely that prices here will be further depressed so long as London is strong, a condition different from that which existed a few weeks back when producers could sell only a part of their output on the foreign market, being restricted by their agreement with the Copper Export Association.

Stocks in consumers' hands are reported light and there seems to be as much activity in manufacturing lines as ever, so that buying should continue in good volume. The large production continues to be the critical factor. With important companies having decided to omit dividends for a time, it may be that there will not be the urge to make a large production at a slight profit per pound, in order to make what money they can. In fact, Calumet & Hecla has already announced a five-day week.

Lead

On Thursday Feb. 21 the American Smelting & Refining Co. advanced its official contract price from 8.50 to 8.70c. per lb., New York, and today, Feb. 27, a further advance to 8.90c. was made.

The market continues very strong and prices have risen in both St. Louis and New York. The attitude of consumers seems to have become somewhat calmer but there is an insistent demand from them to urge producers not only to make early shipment but also to increase their allotments. Prompt lead is exceedingly scarce. One fortunate producer in the West with spot metal on hand has been able to obtain 9.85c., St. Louis, for it in small shipments. However, the metal has also been sold for 9c., March, with an occasional sale made as low as 8.75c. for the same delivery. In New York, activity has been more pronounced than usual and heavy tonnages have been sold by several producers to net 9.25c. New York, chiefly for March delivery. Storage battery and cable business remain the principal consuming branches. One producer feels that after the spring demand for automobiles has been spent there will be a slackening in the demand for battery lead. Owing to the strong market here, it is estimated that fully three-quarters of Mexican production is being consumed in the United States. It is noticeable that the London market has been advancing steadily.

Zinc

Domestic buying of zinc has not been on an extensive scale this week but export sales have supported the market and kept the price from receding more than ten or fifteen points. London has advanced slightly but consistently the last few days. The low-

est price reported for the week was 6.775c. which was done yesterday for a substantial tonnage. Practically all of the demand came from galvanizers. The market for high-grade continues sufficiently good to take care of all available supplies; prices are unchanged from those of last week—8¼@8¾c. delivered.

Tin

The average price of tin for the week was somewhat below that of last week but local buying has not been active at the concessions. Yesterday and today London has been stronger again so that spot tin has been sold here as high as 55c., the volume of sales being small. There is now less of a premium on spot metal; in fact, in the last two or three days, spot and forward quotations have been virtually the same.

Arrivals of tin, in long tons, total 7,095 for the month to date, according to the New York Metal Exchange.

Foreign Exchange

European exchanges show little change over the figures quoted a week ago, but Canadian dollars went to the lowest level reached since 1922. On Tuesday, Feb. 26, cable quotations on francs were 4.26c.; lire, 4.32c.; and Canadian dollars, 3⅛ per cent discount.

Silver

The market is quiet on India and China account. There have been some buying inquiries, however, from Continental sources, although it is too early to determine whether these will materialize into actual purchases.

Mexican Dollars—Feb. 21st, 49; 23d, 49⅛; 25th, 48⅞; 26th, 49; and 27th, 48¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade 28c. per lb.; 98 per cent, 27c. London, £115 per long ton.

Antimony—Per lb.:

Chinese and Japanese brands, 11@11½c..

W. C. C. brand, 12½@13c.

Cookson's "C" grade, 14½c.

Bismuth—$2.35@$2.45 per lb. London, 10s.

Cadmium—70@75c. per lb. London, 2s. 6d.

Cobalt—$2.50@$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—26@30c. per lb. for 99 per cent virgin metal. London, £130 long ton.

Osmiridium — Crude, $58.50 per oz.

Palladium—$83 per oz. Crude, $60 per oz.

Platinum — Refined, $125 per oz. Shading of prices in some quarters. Crude platinum, $115@$117 per oz.

Quicksilver—$59@$61 per 75-lb. flask. San Francisco wires $60.00. London, £9 15s.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten** are unchanged from prices given Feb. 9.

Metallic Ores

Chrome—$19.50@$24, depending upon grade and source. Nominal.

Manganese—44@46c. per long ton unit, seaport, plus duty.

Molybdenum—80c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y:
High-grade wolframite, $9@$9.25.
High-grade scheelite, $9.50.
Ordinary grades, $8.50@$8.75.

Iron Ore, Magnetite, Tantalum, Vanadium, and **Zircon Ore** are unchanged from Feb. 9 quotations.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 23—Zinc blende, per ton, high $46.80; basis 60 per cent zinc, premium, $46@$47; Prime Western, $45; fines and slimes, $44@$41.50; average settling price, all blende, $44.01.

Lead, high, $121.45; basis, 80 per cent lead, $121@122.50; average settling price, all lead, $117.99 per ton.

Shipments for the week: Blende, 14,605 and lead, 2,297 tons. Value, all ores the week, $913,810. Shipments two months: Blende, 106,660; calamine, 68; lead, 15,191 tons. Value, all ores two months, $6,392,140.

Early buying was strong until after midweek, generally on $45 basis for Prime Western grades, the total purchase being 20,400 tons. Today buyers were offering but $44 basis for the same grade of ore. Lead buyers assert the basis price is but $121, but sellers report offerings of $122.50 basis, asserting that a buyer for the St. Joseph Lead Company is taking ore on that basis.

Platteville, Wis., Feb. 16. — Blende, basis 60 per cent zinc, $47 per ton. Lead, basis 80 per cent lead, $120 per ton. Shipments for the week: Blende, 469 tons; lead, 40 tons. Shipments for the year: Blende, 3,812; lead 120 tons. Shipments for the week to separating plants: 808 tons blende.

Platteville, Wis., Feb. 23.—Blende, basis 60 per cent zinc, $48 per ton. Lead, basis 80 per cent lead, $124 per ton. Shipments for the week: Blende, 486 tons; lead, none. Shipments for the year: Blende, 4,298; lead, 120 tons. Shipments for the week to separating plants: 703 tons blende.

Non-Metallic Minerals

Asbestos:

Crude No. 1—$300@$400.
Crude No. 2—$175@$225.
Spinning fibers—$90@$125.
Magnesia and compressed sheet fibers—$60@$90.
Shingle stock—$50@$70.
Paper stock—$32.50@$40.
Cement stock—$20@$25.
Floats—$7@$9.
All per short ton, f.o.b. mines, Quebec, tax and bags included.

Feldspar—In Tennessee.

No. 1 ground, $15.32@$21 per ton f.o.b. mill.

Inferior grades, ground, $10 per ton.

Crude, $6.50 for ordinary grades. As high as $7.50 offered for exceptional quality.

Other quotations in Feb. 9 issue.

Bauxite, Barytes, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Fluorspar, Fuller's Earth, Garnet, Graphite, Gypsum, Ilmenite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Phosphate, Pumice, Pyrites, Rutile, Silica, Sulphur, Talc, Tripoli and **Zircon** are unchanged from Feb. 9 prices.

Mineral Products

Arsenious Oxide (white arsenic)—12@12½c. per lb.

Copper Sulphate—4.75@4.85c. per lb.

Potassium Sulphate, Sodium Sulphate and **Sodium Nitrate** are unchanged from the Feb. 9 prices.

Ferro-Alloys

Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices given in the Feb. 9 issue.

Metal Products

Copper—Sheets, 21c. base; wire, 15½c.

Lead Sheets—Cut, 10.50c.; full, 10.25c. per lb.

Nickel Silver—18 per cent Grade A sheets, 27½c.

Yellow Metal — Dimension sheets, 18¾c.; rods, 15¾c.

Zinc Sheets—Base price, $9.75 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the Feb. 9 prices.

The Iron Trade

Pittsburgh, Feb. 26, 1924

The volume of finished steel buying, in general, has been slightly less in the past week or two than in January. Buyers appear to have become more conservative, and for this there may be reasons in addition to those commonly assigned, the oil scandal and the declines in the share market. As the mills have been operating chiefly on current business, not being well sold ahead except in rails and tin plates, operations are more likely to decrease than increase unless market activity picks up.

Finished steel prices continue at the familiar level but on the whole are perhaps not altogether as steady as in January. There is somewhat increased shading in sheets, while plates have shown additional irregularities.

Pig Iron—The market is disappointing, being dull if not stagnant. Bessemer seems quotable at $23.50, valley, against $23 in January, but basic and foundry are back to their quotations of a month ago, $22 and $23 respectively, at valley furnaces.

Connellsville Coke.—Spot furnace coke stiffened sharply late last week, with $4.25 paid, but it is uncertain whether the price could now be obtained. A little second-quarter business is reported closed at $4.50, but in general consumers have been dropping inquiries, preferring to wait. Spot foundry remains at $5 to $5.50.

Company Reports

The American Metal Co. (Ltd.)

A report of operations of the American Metal Co., Ltd., for 1923 states that during the latter part of the year the outstanding stock of the company was increased 54,790 shares by exchanges with the stockholders of the Compania Minera de Penoles, S. A., on the basis of one share of the stock of the company, plus a cash payment of $5 per share, for two shares of the stock of the Penoles company. The company now owns in excess of 90 per cent of the outstanding shares of the stock of the Penoles company.

During the year the company paid out of current earnings dividends on its preferred stock at the yearly rate of $7 per share and on its no par value common stock at the yearly rate of $3 per share.

While the year started out with a great deal of promise, the business of the company, after the spring months, was affected by unsettled market conditions. Zinc smelting operations are unprofitable, as the margin between ore and zinc prices has for some months been wholly inadequate. The production of zinc ore is being kept within the requirements of the smelting works which, however, have been turning out more metal than the market will take. A similar situation exists in the copper industry. In spite of an extraordinary heavy consumption, copper is selling at a level so low that among the important basic commodities it is, relatively, perhaps the cheapest. Sound conditions prevail in the lead and tin producing industries, where there has been no undue stimulation of production. Taking all these factors into account, the financial results for the past year have been satisfactory.

All signs point to the continuance of a large volume of business for the current year.

Consolidated Balance Sheet, Dec. 31, 1923

ASSETS

Current:		
Cash		$3,954,106.81
Accounts and notes receivable, net of reserve		6,088,913.61
Inventories: Metals on hand or represented by metal contents of ores at market prices, Dec. 31, 1923		13,732,781.50
Advances against ores in process and in transit		1,274,068.86
Investments in securities		1,229,050.03
Deferred expenses applicable to future operations		2,521,534.50
		$28,800,455.31
Fixed:		
Mines, smelters, real estate, machinery and equipment	$27,748,692.35	
Less: Reserve for depletion, depreciation and obsolescence	10,079,817.24	
	$17,668,875.11	
Investment in capital stocks of foreign allied companies	1,373,954.95	
		$19,042,830.06
		$47,843,285.37

LIABILITIES

Current:		
Acceptances against letters of credit		$2,060,901.54
Accounts payable		5,376,179.86
Deposits due officers and employees		2,441,007.09
Accrued liabilities and reserves		223,510.62
Accounts of purchase of smelter, payable July 1, 1924		250,000.00
Tax reserve		155,840.56
Total current liabilities		$10,507,439.67
Purchase Money Mortgages and Deferred Liabilities:		
First mortgage sinking fund bonds, due Feb. 1, 1938 (coal lands, Langeloth, Pa.)	$357,000.00	
Real estate mortgages, Chrome, N. J.	8,000.00	
		365,000.00
Contingent reserves		3,739,811.02
Capital stock:		
Minority interest in subsidiary companies	$1,295,359.98	
The American Metal Co. (Limited): Preferred stock 7 per cent cumulative, $5,000,000 (par value $100, liquidation value $110 per share); Common stock, 590,790 shares no par value (total authorized 1,000,000 shares)	23,783,500.00	
	$25,078,859.98	
Surplus	8,152,174.70	
		33,231,034.68
		$47,843,285.37

Consolidated Surplus Statement

Surplus at beginning of year		$7,441,435.42
Income from operations during year (including approximately 90 per cent of the year's earnings of the Cia. Minera de Penoles, S. A.) after deducting all expenses including management's share of profits under contract	$4,948,467.54	
Less: Depreciation, depletion, extraordinary repairs and obsolescence	$1,245,261.26	
Special appropriation to general reserve	1,000,000.00	
	2,245,261.26	
Net income	$2,703,206.28	
Less Dividends: Preferred, $7 per share on 50,000 shares	$350,000.00	
Common, no par value stock, at the rate of $3 per annum on 536,000 shares and on additional shares as issued	$1,642,467.00	
	1,992,467.00	
Balance added to surplus		710,739.28
Surplus on Dec. 31, 1923		$8,152,174.70

Hollinger Consolidated Gold Mines, Ltd.

Gold; Timmins, Ont.

A report of operations of Hollinger Consolidated Gold Mines, Ltd., for 1923 states that the net profits for the year were $4,374,486.75, out of which thirteen dividends of 1 per cent each, amounting in all to $3,198,000, were paid, leaving a balance of $1,176,486.75 available for Dominion, provincial and municipal taxes, which amounted to $451,621.76, and depreciation and donations, requiring $970,829.34, but as these two items aggregated in all $1,422,451.10, it was necessary to encroach upon surplus to the extent of $245,964.35, which resulted in a reduction of the surplus from $5,909,469.77, shown at the beginning of the year, to $5,663,505.42, which is still entirely represented by cash and investments.

The power development at the island portage on the Abitibi River is now under construction and fair progress is being made. The contracts have been let for the dam, power house and subsidiary structures, as well as for the turbines, generators, transformers and electrical and other apparatus. The cable for the transmission line and a number of the towers are already on the ground and good progress is being made with clearing the power transmission line.

The immediate development contemplates two units of 12,500 hp. each with provision to increase to the full capacity of the Abitibi River when actual operating conditions demonstrate that a sufficiently reliable flow of water warrants it.

"The power development has been financed up to the present time out of the company's cash balances, the amount paid out for this purpose to date being about $500,000. To take care of future financing the directors have been fortunate in arranging a loan of $3,500,000 to be advanced as and when required at 6 per cent interest, and to be secured by the hypothecation of certain of the company's securities. It is expected that this sum will be sufficient to complete the development, the total cost of which is estimated at about $4,000,000.

"As a result of the year's operations, it was necessary to encroach upon surplus to the extent of $245,964.35 contrasted with an addition to the surplus of $1,948,690.27 during the year 1922. This unfavorable showing is entirely due to the failure of the power supply during the early part of the year, and while it is true that the profits earned in spite of the power shortage were considerably in excess of the present dividend requirements, the directors are still of the opinion that any increase in the dividend rate should remain in abeyance until the power situation has been stabilized so that any addition to the dividend once made may be considered as reasonably permanent. During the comparatively short period of its existence the company has disbursed in dividends a larger proportion of its profits than any of the other large gold mining companies at present operating in any part of the world."

The average tons milled per day amounted to 3,764 as compared with 4,097 in 1922 and the grade was $7.93 compared with $8.53. Tons of ore milled amounted to

1,366 352. The decrease in values was due to the large quantity of low-grade development rock which it was necessary to send to the mill, as there was no means of storing such a large tonnage of ore. However, some 20,000 tons were tipped into empty stopes and after the resumption of normal working, were sent to the mill. During the last half of the year, the tons treated have averaged something in excess of 4,250 per day and the grade improved approximately to the figures of 1922.

Balance sheet as of Dec. 31, 1923 is as follows:

ASSETS

Capital		
Mining properties		$22,493,785.17
Plant. Brought forward from 1922	$1,637,378.59	
Additions during 1923	793,600.03	
	$2,430,978.62	
Less depreciation for 1923	907,039.95	
		$1,523,938.67
Investments in other companies and properties		43,563.84
Abitibi power development		262,418.14
Tailings disposal site		71,542.80
		$24,395,248.62
Current		
Accounts receivable	$67,540.95	
Accrued interest on Victory Loan, etc.	37,627.48	
Charges paid in advance—fire insurance	12,878.00	
Cash on hand	353,172.56	
Guarantee deposits	300.00	
Bullion in transit	716,362.90	
Material and supplies on hand	759,852.25	
Solutions and slags on hand	108,099.35	
Investments	4,433,408.83	6,589,242.32
		$30,984,490.94

LIABILITIES

Capital Stock		
Authorized	$25,000,000.00	
In treasury	400,000.00	
		$24,600,000.00
Current liabilities		490,985.52
Reserve for Dominion of Canada 1923 taxes		230,000.00
Surplus		
Balance of account from 1922	$5,909,469.77	
Profits from Jan. 1st. to Dec. 31, 1923	3,922,864.99	
	$9,832,334.76	
Less—Dividends	$3,198,000.00	
Plant depreciation	907,039.95	
Donations	1,285.00	
Tailings disposal site depreciation	12,625.20	
Abitibi power depreciation	46,309.08	
Investments in other companies and properties written down	3,570.11	
	$4,168,829.34	
Net surplus carried forward		$5,663,505.42
		$30,984,490.94

Profit and Loss Statement for Year 1923

Sources of 1923 Income from			
Gold and silver produced			$10,446,412.20
Premium on U. S. exchange			175,850.27
Interest on investments and other income			391,939.84
			$11,014,202.31
Disposal of 1923 income			
General charges		$577,521.49	
Mining charges		4,499,565.53	
Milling charges		1,562,628.54	
			6,639,715.56
Operating profit			4,374,486.75
Paid out in dividends			3,198,000.00
			$1,176,486.75
Deduct			
Taxes, Province of Ontario	$153,688.34		
Municipal taxes	67,933.42		
Dominion of Canada 1923 Taxes	$230,000.00		
		$451,621.76	
Depreciation		969,544.34	
Donations		1,285.00	
			$1,422,451.10
Deducted from surplus			$245,964.35

Bullion Statement

Inventory, Jan. 1, 1923		
Solutions		$102,513.65
Slags, litharge and miscellaneous		2,150.00
Total		$104,663.65
Value produced in 1923		
Ore milled	$10,841,106.20	
Tailings loss	394,694.00	
		10,446,412.20
		$10,551,075.85
Inventory, Dec. 31, 1923		
Solutions		$103,399.35
Slags, litharge and miscellaneous		4,700.00
		$108,099.35
Bullion shipped during 1923		$10,442,976.50
		$10,551,075.85

United Verde Extension Mining Co.

A report of operations of the United Verde Extension Mining Co. for the year ended Dec. 31, 1923, states that the output somewhat exceeded the program as defined in the last annual report because of the advance in the price of copper in March and April, 1923, to above 17c. Believing that this high price was only temporary, output was increased to take advantage of it, resulting in a total output for the year of 41,855,959 lb. of copper, 8,992 oz. of gold and 257,602 oz. of silver, smelted from 172,629 dry tons of ore. Copper on hand Dec. 31, 1923, was 11,444,724 lb.

There have been increases in ore tonnage as a result of development in fingers from the main orebody on the hanging-wall side of the fault.

Notwithstanding the considerable footage run in the Jerome Verde ground, no ore has been discovered, but in some places in the upper levels—notably on the 950—very likely looking ground has been encountered.

Ore Reserves: The amount of ore developed above the 1,600 level is 940,786 tons averaging 9.97 per cent copper, 0.031 oz. gold, 2.05 oz. silver.

Construction: A new schoolhouse is being built at Clemenceau, and a new turbine is being installed in the power house at the smelter, at a total cost of about $160,000.00, of which approximately one-half has been paid.

Costs: The table below shows the average cost per pound of copper produced during the year.

Mining	$0.0272
Smelting	.0231
Freight on ore	.0008
Freight on bullion, refining and selling	.0208
Other expenses	.0008
	$0.0727

These costs do not include (1) depreciation, (2) reserve to return capital (depletion), (3), taxes.

Mine Valuation: Under Federal Tax Laws, the company, in determining taxable income, is entitled to a reasonable allowance for depletion, based upon a valuation of its properties on Dec. 31, 1916. The company, in 1917, claimed and set up on the books, a valuation of $40,000,000. This item has appeared continuously on the balance sheet. Only recently has the valuation been finally fixed and approved by the Federal authorities at $31,600,000 and the item in the balance sheet has been reduced accordingly.

"General: General conditions improved during the year, and as a result of the suit against the State for overtax assessment an amicable settlement was reached in January, 1924, at which time a full report on ore reserves was presented to the Tax Commission and, on agreeing to pay the back taxes, the valuation for taxation purposes in future years will be reduced to more nearly conform to actual values. Although we feel that the company has paid more than its share of taxes, both State and Federal, as a result of the war, we have been unable to secure recovery."

Statement of Earnings

Gross revenue from metals and ore produced		$6,445,033.59
Other revenue		329,198.13
		$6,774,231.72
Deductions:		
Mine and smelter operating, freight, refining and selling expenses	$3,006,836.59	
Other expenses	663,757.71	
		3,670,594.30
Earnings from operations		$3,103,637.42
Less:		
Amounts written off to reserves for depletion and depreciation		2,852,316.04
Net profit to surplus		$251,321.38

Balance Sheet

ASSETS

Mining property		$34,842,195.37
Less: Depletion reserve		16,968,382.08
		$17,873,813.29
Smelter plant, mine and other machinery equipment and buildings	$5,844,485.66	
Less: Depreciation	3,370,117.31	
		2,474,368.35
Investments, at cost		1,743,144.51
Lands, ranches, etc.		322,684.72
Accounts and notes receivable, including interest accrued		371,047.22
Inventories of materials and supplies		330,094.98
Cash in banks and on hand		1,069,110.64
U. S. Treasury certificates		200,000.00
Liberty bonds, at par		3,363,950.00
Due on metals sold, ore and bullion on hand		2,214,191.08
		$29,962,404.79

LIABILITIES			
Capital stock, authorized			$750,000.00
Less treasury stock			225,000.00
			$525,000.00
Accounts payable, including taxes and other accrued charges			1,291,237.19
Reserve for liability insurance			98,304.32
Surplus, balance on Jan. 1st, 1923	$37,518,817.33		
Deduct adjustment from re-appraisal	6,805,763.92		
Adjusted balance as at Jan. 1st, 1923	$30,713,053.41		
Less part of dividend 28, together with dividends 29 and 30 paid out of reserve fund for depletion	2,665,190.13		28,047,863.28
			$29,962,404.79
Surplus account, debit balance as at Jan. 1st, 1923	$520,831.26		
Credit adjustment of previous depletion charges	1,279,319.75		
Adjusted balance as at Jan. 1st, 1923	$758,488.49		
Add net profit for 1923	251,321.38		
	$1,009,809.87		
Deduct dividend 27 and part of 28	1,009,809.87		
			$29,962,404.79

Wright-Hargreaves Mines, Ltd.

Gold, silver; Kirkland Lake, Ont.

A report of operations of Wright-Hargreaves Mines, Ltd., for 1923 states that the mill treated 79,242 tons of ore, from which $754,978.81 was taken in bullion. The amount of gold produced was practically the same as for the year 1922, while the tonnage treated was approximately 15,000 tons more, or an average of 20 tons per day increase. The total costs for the entire year were approximately 40c. per ton less than for the previous year.

The bullion taken from the ore treated averaged $9.52 per ton for the year, whereas the average for 1922 was somewhat higher. This is due to the fact that considerably more development work was done during the year than heretofore and that all ore from this development work, including some low grade, went to the mill for treatment, thus reducing the mill heads for the year.

Balance Sheets, Dec. 31, 1923

ASSETS			
Current Assets (Cash $234,189.16)			$373,287.89
Capital Assets			
Mining properties		$1,500,000.00	
Plant and equipment, Jan. 1, 1923	$402,985.13		
Additions, 1923	31,391.31		
	$434,376.44		
Less depreciation	99,469.89	334,906.55	
Preliminary development cost	269,682.08		
Less written off	163,401.30	106,280.78	1,941,187.33
			$2,314,475.22
LIABILITIES			
Current Liabilities			$54,440.06
Capital Stock			
Authorized and issued		2,750,000.00	
Less shares discount		545,003.20	2,204,996.80
Surplus			
Balance from 1922 statement		6,423.87	
Net from operation—1923		304,904.86	
		311,328.73	
Deduct			
Dividends—1923	$137,500.00		
Taxes—prior years (underestimated)	4,236.32		
1923 taxes—payable 1924	20,000.00		
Preliminary development cost (charged off 1923)	94,554.05	256,290.37	
			55,038.36
			$2,314,475.22

Profit and Loss Statement

Bullion Production			$754,978.81
Operation Costs			
Development and exploration	$72,076.47		
Stoping	125,653.79	$197,730.26	
Transporting ore (hoisting, etc.)		44,346.56	
Milling charges		123,196.81	
Market bullion		5,390.12	
General and undistributed charges		57,944.16	
Depreciation plant and equipment		41,424.68	470,032.59
			$284,946.22
Other Income			19,958.64
			$304,904.86

Nevada Consolidated Copper Co.

A statement of operations of the Nevada Consolidated Copper Co. for the fourth quarter of 1923 gives the following production in pounds:

FOURTH QUARTER, 1923		THIRD QUARTER, 1923	
October	6,020,603	July	5,254,796
November	5,981,914	August	5,881,420
December	5,851,202	September	5,999,167
Total	17,853,719		17,135,383

A total of 838,294 tons dry weight of Nevada Consolidated ore, averaging 1.27 per cent copper, was milled and 9,799 dry tons of Ruth mine direct smelting ore, averaging 7.07 per cent copper was shipped to the smelter.

The cost of production, including current charges for depreciation of plant and equipment and all fixed and general expenses, and after credit for gold and silver values and miscellaneous earnings, was 10.95c. per lb. of copper produced, compared with 11.16c. for the preceding quarter.

The financial outcome of operations follows:

	Fourth Quarter, 1923	Third Quarter, 1923
Operating gain from production of copper	$198,423.61	$431,035.36
Value gold and silver and miscellaneous earnings	264,359.90	219,719.56
	$462,783.51	$650,754.92
Plant and equipment depreciation	131,530.05	131,530.05
Increase in earned surplus	$331,253.46	$519,224.87

Earnings for the quarter are based upon an average carrying price of 12.81c. per lb. of copper, compared with 14.18c., 15.26c., and 15.65c., for the third, second and first quarters, respectively.

Reconstruction of the concentrating plant progressed during the year to the completion of two units with a capacity of about 9,500 tons per day—the tonnage now being treated. Improvements under way in some of the details of the flow sheet are expected to effect and maintain an average mill recovery of 85 per cent over the 1924 yearly period on ore of the usual grade. The superstructure for the third unit of the mill and the steel ore bins for this unit are practically complete and ready for machinery.

Ray Consolidated Copper Co.

The fiftieth quarterly report of the Ray Consolidated Copper Co. covering the fourth quarter of 1923 states that the total net production of copper from all sources was 15,044,504 lb., as shown in tabulation below.

FOURTH QUARTER,	Pounds	THIRD QUARTER	Pounds	SECOND QUARTER	Pounds
October	5,153,989	July	4,832,189	April	4,968,288
November	4,424,600	August	5,447,123	May	5,951,344
December	5,465,915	September	5,724,249	June	5,408,067
Totals	15,044,504		16,003,561		16,327,699

A total of 718,500 tons dry weight of ore, averaging 1.49 per cent copper, was milled, being an average daily tonnage of 7,810 tons, compared with 7,638 tons per day for the previous quarter. The mill recovery was 72.46 per cent of the total copper contained in concentrating ores, compared with 72.93 per cent for the previous quarter. The underground development was advanced 7,942 ft., making the total development to date 826,377 ft. The average cost per net pound of copper produced was 12.91c., compared with 12.73c. for the previous quarter. Both figures include depreciation and all fixed and general expenses of every kind, and also take into account miscellaneous income and the value of gold and silver recovered.

The financial results of operations follow:

	Fourth Quarter, 1923	Third Quarter, 1923	Second Quarter, 1923
Operating profit from production of copper	$3,179.14	$343,302.90	$496,508.95
Miscellaneous income and gold and silver	82,487.17	100,998.56	74,636.61
Total income	$85,666.31	$444,301.46	$571,145.56
Depreciation	111,628.75	107,595.48	110,425.95
To surplus	(a)$25,962.44	$336,705.98	$460,719.61

(a) Decrease.

The average carrying price of copper for the quarter was 12.738c., compared with a carrying price of 14.833c. for the previous quarter.

Two sections of the Hayden concentrator have been remodelled during the year showing satisfactory results in increased recoveries and an appreciable decrease in costs.

MINING STOCKS

Week Ended February 23, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	*40	*40	*40		
Anaconda	New York	40⅜	38½	39½	De.15, Ja.21, Q	0.75
Aracadian Consol.	Boston	2⅛	1⅞	2		
Ariz. Com'l.	Boston	9¼	9	9¼	Ja.15, Ja.31	0.50
Calaveras	N. Y. Curb	1¼	1	1¼		
Calumet & Arizona	Boston	47	45½	46	De.7, De.24, Q	0.50
Cal. & Hecla (New)	Boston	17⅛	16	16	De. 1, De. 17	0.50
Canario Copper	N. Y. Curb	2 5/16	2⅛	2 5/16		
Cerro de Pasco	New York	48⅜	46⅜	47⅛	Ja. 17, Feb. 1	1.00
Chile Copper	New York	28⅜	27½	28	Mh.1 Mh.20, Q	0.62½
Chino	New York	20	18⅝	18⅞	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	3⅛	2⅞	3⅛		
Copper Range	Boston	25⅛	24	24⅛	May '23, Q	1.00
Crystal Copper	Boston Curb	*79	*78	*78		
Davis-Daly	Boston	4 7/16	4	4 7/16	Mar. '20, Q	0.25
East Butte	Boston	5	4½	4½	Dec. '19, A	0.50
First National	Boston Curb	*25	*25	*25	Feb. '19, SA	0.15
Franklin	Boston	*99	*80	*80		
Gadsden Copper	Boston Curb	*50	*35	*50		
Granby Consol.	New York	17⅛	16	17	May '19, Q	1.25
Greene-Cananea	New York	16⅜	14⅞	16⅛	Nov. '20, Q	0.50
Hancock	Boston	1⅛	1⅛	1⅛		
Howe Sound	N. Y. Curb			2⅛	Ja.2, Ja.15	0.05
Inspiration Consol.	New York	27⅜	25⅞	26	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	†3½	†3	3½	May 23, K	0.15
Isle Royale	Boston	17⅜	16	16	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	1⅜	1⅛	1⅛		
Kennecott	New York	38⅜	36½	37⅛	De.7, Ja. 2, Q	0.75
Keweenaw	Boston	1	*75	1		
Lake Copper	Boston	1⅜	1⅛	1⅛		
Magma Copper	New York	33⅜	33	33	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb			1⅜		
Mass Consolidated	Boston	*90	*75	*90	Nov. '17, Q	1.00
Miami Copper	New York	23¼	22⅛	22⅛	Fe. 1, Fe. 13, Q	0.50
Michigan	Boston			*50		
Mohawk	Boston	35⅛	34	34	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	9⅛	8⅞	8⅞	De.14, De.31	0.50
Nevada Consol.	New York	14⅛	13½	14	Sept. '20, Q	0.25
New Cornelia	Boston	18⅛	17	18⅛	Au.3, Au.20, Q	0.25
New Dominion	N. Y. Curb	2⅜	2⅜	2⅜		
North Butte	Boston	3⅛	3	3	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*78	*71	*71		
Old Dominion	Boston	17	17	17	Dec. '18, Q	1.00
Osceola	Boston			31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†140	†130		De.20, Ja.2 Q	1.00
Quincy	Boston	22⅞	21½	21½	Mar. '20, Q	1.00
Ray Consolidated	New York	12⅛	11⅜	11⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*17	*13	*13		
St. Mary's Min. Ld.	Boston	35	33½	33½	No.9, De.11, K	1.00
Seneca Copper	New York	6½	5⅞	6⅛		
Shannon	Boston	*65	*40	*50	Nov. '17, Q	0.25
Shattuck Arizona	New York	6⅜	6⅛	6⅜	Jan. '20, Q	0.25
South Lake	Boston			¼		
Superior & Boston	Boston	*95	*81	*95		
Tenn. C. & C. cfs.	New York	9⅛	8⅞	9	De.31, Ja.15, Q	0.25
Tuolumne	Boston			*42	May '13,	0.10
United Verde Ex.	N. Y. Curb	26¼	24½	25	Ja.1, Fe. 1, Q	1.00
Utah Consol.	Boston			*1	Sept. '18,	0.25
Utah Copper	New York	69	66½	66½	De.3, De.15, Q	1.00
Utah Metal & T.	Boston	*30	*30	*30	Dec. '17,	0.30
Victoria	Boston	*75	*65	*65		
Walker Mining	N. Y. Curb	3	2⅞	3		
Winona	Boston	*25	*25	*25		
Wolverine	Boston			5¾		
NICKEL-COPPER						
Internat. Nickel	New York	13⅜	12⅞	13⅛	Mar. '19,	0.50
Internat. Nickel pfd.	New York	82¼	79¼	79¼	Ja.17, Fe.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	2⅜	2⅛	2⅜		
National Lead	New York	143	138	140¼	Mh.14, Mh.21, Q	2.00
National Lead pfd.	New York	114	114	114	No. 23, De. 15	1.75
St. Joseph Lead	New York	27⅛	25	26⅞	De.9, De.20	0.50
ZINC						
Am. Z. L. & S.	New York	9⅛	9⅛	9⅛	May '20	1.00
Am. Z. L. & S. pfd.	New York	34⅛	34	34	Nov. '20, Q	1.50
Butte C. & Z.	New York	6⅛	5⅜	5⅜	Ma., '23,	0.50
Butte & Superior	New York	20⅛	18⅛	18⅝	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	5⅛	5⅛	5⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	150	147	149	Ja.31, Fe.9	2.00
United Zinc	N. Y. Curb			*25		
Yellow Pine	Los Angeles	*80	*75	*75	Dec. '23	0.03
SILVER						
Alvarado	N. Y. Curb			1¼		
Batopilas Mining	New York			⅛	Dec. '07, I	0.12
Beaver Consol.	Toronto	*27½	*26	*27	May '20, K	0.03
Castle-Trethewey	Toronto	*67	*64	*64		
Coniagas	Toronto	2.30	2.20	2.20	Oc.19, No.1, '23	0.02½
Crown Reserve	Toronto	†*62	†*60	*68	Jan. 17,	0.05
Kerr Lake	N. Y. Curb	2	2	2	Oc. 1, Oc. 15, Q	0.12½
La Rose	Toronto	*24	*21	*21	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*16¼	*13½	*16	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.68	3.40	3.68	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6⅛	6⅛	Ja.1, Ja.21, QX	0.30
Ontario Silver	New York	6⅞	6⅞	6⅞	Jan. '19, Q	0.50
Temiskaming	Toronto	*32	*32	*32	Jan. '20, K	0.40

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York			¼		
Alaska Juneau	New York	1	1	1		
Carson Hill	Boston	2⅛	1⅞	1⅞		
Cresson Consol. G	N. Y. Curb	4	3⅞	4	De.31, Ja.10, Q	0.10
Dome Mines	New York	17⅞	17⅛	17⅛	De.31, Ja.2, Q	0.50
Golden Cycle	Colo. Springs	1.27	1.27	1.27	De. '22, Q	0.02
Hollinger Consol.	Toronto	11.95	11.60	11.90	Fe.7, Fe.25, M	0.05
Homestake Mining	New York	53⅜	52⅛	52⅞	Fe.20, Fe.25, M	0.50
Kirkland Lake	Toronto	*20½	*19½	*19½		
Lake Shore	Toronto	3.60	3.56	3.60	Fe.2, Fe.24, Q	0.02
McIntyre-Porcupine	New York	16⅞	16¼	16⅜	De. 1, Ja. 2,	0.25
Portland	Colo. Springs	*43	*40	*43	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1⅛	1⅛	1⅛		
Tom Reed	Los Angeles	*43	*42	*42	Dec. '19,	0.02
United Eastern	N. Y. Curb	*98	*93	*95	Ja.8, Ja.28, Q	0.15
Vipond Cons.	Toronto	1.29	1.20	1.26		
Wright-Hargreaves	Toronto	3.00	2.95	3.00	Se.15, Oc.1, Q	0.02
Yukon Gold	N. Y. Curb	*75	*65	*70	June '18,	0.02
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb			*17		
Con. Cortez	N. Y. Curb	*67	*64	*67		
Con. Virginia	San Francisco	*6½	*5½	*6½		
Continental Mines	N. Y. Curb			4		
Dolores Esperanza	N. Y. Curb	*65	*60	*60	Jy. 1, Jy. 10	Q 0.05
Jib Consol	N. Y. Curb	*50	*25	*25		
Premier Gold	N. Y. Curb	2⅛	2⅛	2⅛		
Tonopah Belmont	N. Y. Curb	*66	*63	*65	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*38	*36	*36	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2	1 13/16	1 13/16	Dec 11, Ja. 1	0.05
Tonopah Mining	N. Y. Curb	1 13/16	1 13/16	1⅞	Se.30, Oc. 1	0.07½
Unity Gold	N. Y. Curb	2⅛	1⅞	2⅛		
West End Consol.	N. Y. Curb	*74	*70	*74	Mar. '23, Q	0.05
SILVER-LEAD						
Ahumada	Boston Curb	6⅜	6⅛	6⅛	De.15, Ja.2, X	0.10
Bingham Mines	Boston	17⅛	17	17⅛	Sept. '19, Q	0.25
Cardiff M. & M.	Salt Lake			*85	Dec. '20,	0.15
Chief Consol.	Boston Curb	4	3⅜	4	Ja.11, Fe.1, Q	0.10
Columbus Rexall	Salt Lake	*29	*29	*29	Aug. '22	0.03
Consol. M. & S.	Montreal	37	35½	36⅞	Oct. '20, Q	0.62½
Daly Mining	Salt Lake			1.77½	July '20	0.10
Erupcion	Boston Curb	2¼	2¼	2¼	De. 15, Ja. 2, X	0.125
Federal M. & S.	New York	13	13	13	Jan., '09	1.50
Federal M. & S. pfd.	New York	47⅜	45½	46⅜	Fe.26, Mh.15, Q.	1.75
Florence Silver	Spokane	*24	*20	*20	Apr. '19, QX	0.01
Hecla Mining	N. Y. Curb	9	9	9	Fe.15, Mh.15	Q 0.25
Indian Mines	N. Y. Curb			*64		
Iron Blossom Con.	N. Y. Curb			*31	Oct. 26, '23,	0.02
Marsh Mines	N. Y. Curb	*12	*12	*12	June '21, I	0.02½
Park City	Salt Lake			4.75	Jan. 24,	0.15
Park Utah	N. Y. Curb			4⅜	De.8, Ja.2, Q	0.15
Prince Consol.	Salt Lake			*75	Nov. '17,	0.02
Silversmith	Spokane	*32	*31	*32	Oc. 1, Oc. 10	0.01
Simon Silver-Lead	N. Y. Curb			*1		
Tamarack-Custer	Spokane	1.35	1.35	1.35	Se.30, Oc. 1, K	0.02
Tintic Standard	Salt Lake	4.00	3.97½	4.00	Ja. 5, X	0.25
Utah-Apex	Boston	3	2⅞	3	June '23, QX	0.50
IRON						
Bethlehem Steel	New York	58⅞	55½	57⅞	Mh. 1, Ap. 1, Q	1.25
Char. Iron	Detroit			1½		
Char. Iron pfd.	Detroit			2		
Colorado Fuel & Iron	New York	28	25⅞	27⅞	Fe.11, Fe.25	Q 2.00
Col. Fuel & Iron pfd.	New York			102	Fe.11, Fe.25, Q	2.00
Gt. North'n Iron Ore	New York	29⅜	28⅝	29⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb			46	Mh.15, Apl. 1	Q 0.62½
Mesabi Iron	N. Y. Curb			6⅜		
Replogle Steel	New York	11½	11	11¼		
Republic I. & S.	New York	57½	54⅜	57⅜	May '21	1.50
Republic I. & S. pfd.	New York			93	Mh.20, Ap.1	QX 2.75
Sloss-Sheffield S. & I.	New York	63	58	63	Feb. '21,	1.50
Sloss-Shef. S. & I. pfd.	New York	84	84	84	De.20, Ja.2, Q	1.75
U. S. Steel	New York	105⅛	102	104⅛	Mh. 29, QX	1.75
U. S. Steel pfd.	New York	119½	119½	119½	Mh.29, Q	1.75
Virginia I. C. & C.	New York			49	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York			80	De.15, Ja.22	2.50
VANADIUM						
Vanadium Corp.	New York	31¼	29¼	30⅜	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal			30	Se.29, Oc.15	Q 1.00
Asbestos Corp. pfd.	Montreal	59	59	59	Se.29, Oc.15, Q	1.50
SULPHUR						
Freeport Texas	New York	10⅛	10⅛	10⅛	Nov '19, Q	1.00
Texas Gulf	New York	64	62⅛	63	Mh.3, Mh.15	QX 1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	4	3¾	3⅞		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	44⅛	43½	44⅛	Fe.18, Mh.1, Q	0.75
Amer. Metal pfd.	New York			113⅜	Fe.20, Mh.1, Q	1.75
Amer. Sm. & Ref.	New York	63	61	62	Ja. 11, Fe. 1, Q	1.25
Amer. Sm. & Ref. pfd.	New York	99	99	99	Fe.20, Mh.1,	1.75
U. S. Sm. R. & M.	New York	23⅜	22	22⅛	Jan. '21, Q	0.50
U.S. Sm. R. & M. pfd.	New York	39⅛	39⅛	39⅛	Ja.7, Ja.15	Q 0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial, X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.